FEBRUARY 13, 1961

nissiles and rockets

HE MISSILE/SPACE WEEKLY

V.8 #7

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FEB 13 1961

TECHNOLOGY DEPARTMENT

Minuteman's Triumphant Take-off

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New Family of Tape Recorders for Space . 24

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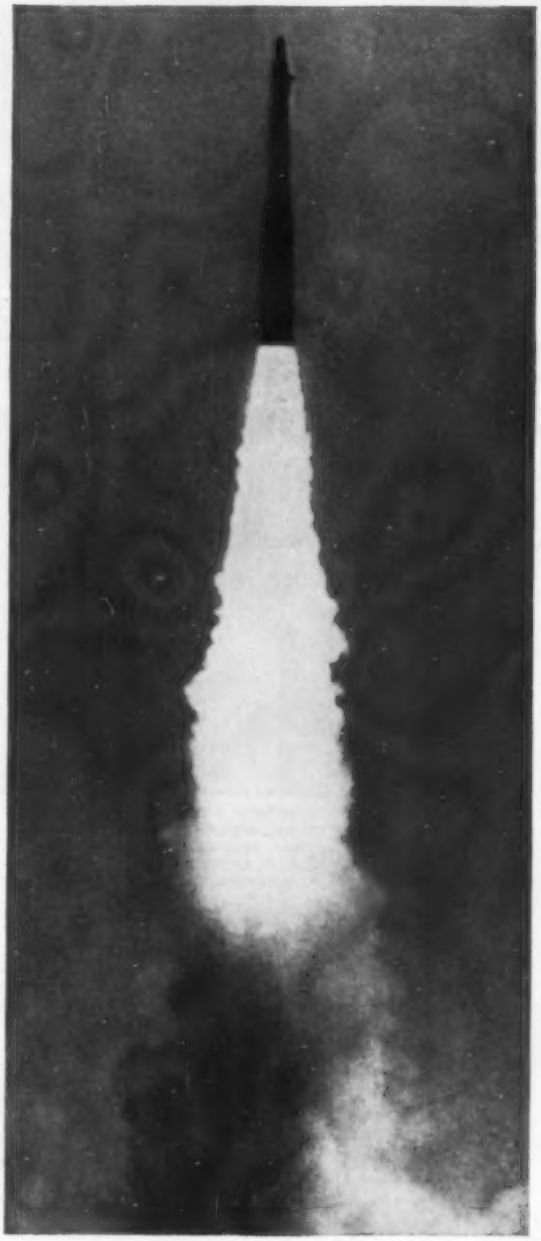
MINUTEMAN



Reliable power for peace at reasonable price, U.S. Air Force Minuteman which will be America's first ICBM with solid rocket motors successfully met its objectives in its initial full scale flight down the Atlantic Missile Range. First stage motor of the three stage Minuteman is designed and produced by Thiokol Chemical Corporation. During early test phases, Thiokol motors performed so superbly the original schedule of preliminary firings was cut to less than half, greatly accelerating the entire Minuteman development program. Through Thiokol engineered reliability, the nation's power to deter war is moving up while anticipated costs come down.

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THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 8, No. 7 February 13, 1961

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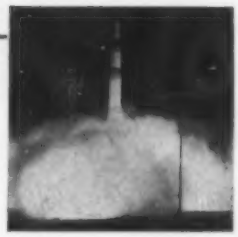

THE COVER

Full-scale Minuteman blasts away from Cape Canaveral in highly successful first flight test. The Defense Department is weighing a plan to double production rate. *See p. 12.*

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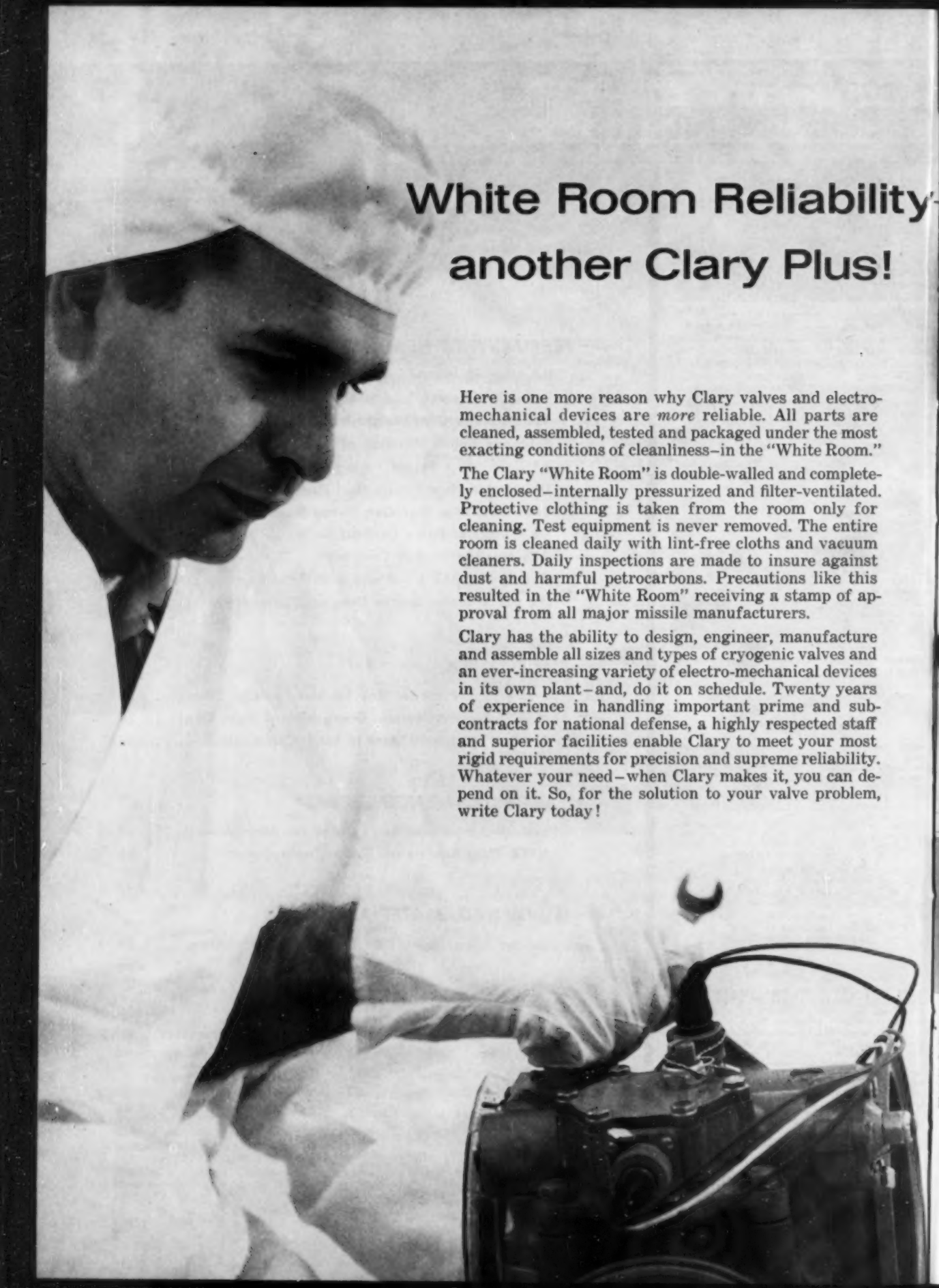

White Room Reliability another Clary Plus!

Here is one more reason why Clary valves and electro-mechanical devices are *more* reliable. All parts are cleaned, assembled, tested and packaged under the most exacting conditions of cleanliness–in the "White Room."

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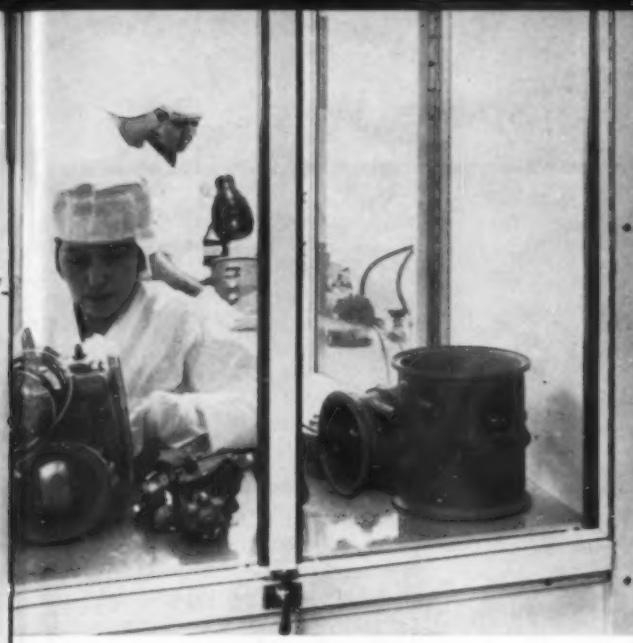

RECEIVING, CLEANING AND INSPECTION All parts are thoroughly cleaned when received through the "White Room" double-door airlock. Daylight visual inspections are made for signs of contamination. Parts that will come in contact with liquid oxygen are inspected with ultraviolet for petroleum-type hydrocarbons.

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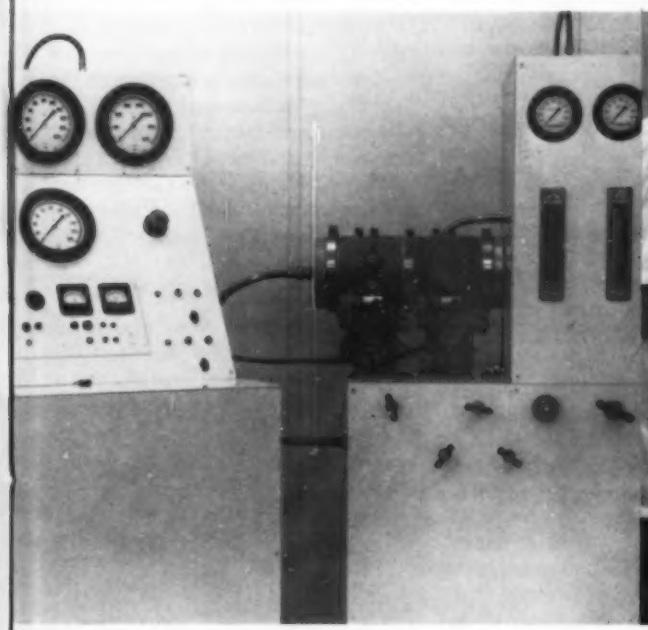

FINAL INSPECTION AND TESTING Again, inspections are made for contamination. Influent and effluent tests of the entire unit are conducted to spot any flaw or weakness that might possibly hinder optimal performance. The results of these tests are carefully checked by quality control personnel.

4. PACKAGING Units and subassemblies that can meet rigid quality control specifications are tagged and packaged. Each unit is double-wrapped in heavy polyethylene and heat sealed. Quality control checks are made to insure proper packaging. Only then is a new Clary product ready to leave the "White Room."

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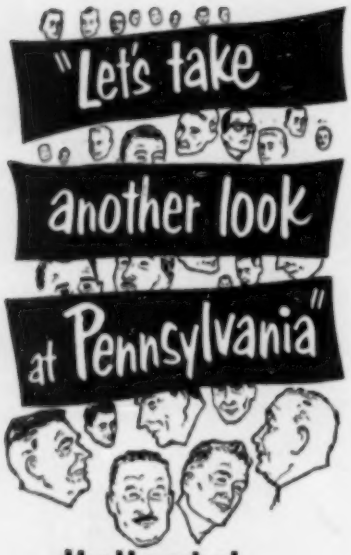

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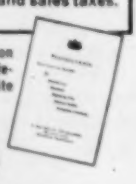

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The Missile/Space Week

New Segmented Rocket Test

"Huge versions" of conical segmented solid rocket may be tested soon by United Technology Corp. The company has successfully fired a 15,000 lb. thrust model with a specific impulse about the same as *Minuteman*. Segments were joined by a modified bolted flange instead of a tongue-and-groove design secured by shear pin used in two earlier tests. The three segments totaled 7 ft. in length and were 3.5 ft. in diameter.

Polaris A-2 Fails

Within a month the Navy expects to launch another *Polaris A-2*—testing the same type of vehicle which ruptured and exploded on the pad last week. The shot was the first failure of the longer range (2500-mile) bird in four attempts with the new Hercules Powder Co. glass case.

The spectacular failure was remarkably similar to one involving a *Polaris AX-2* on Oct. 15, 1958. In both instances the second stage tore loose into the air while the first stage remained on the pad, spewing flames from both ends.

Last week, the Navy assigned construction of five new *Polaris* subs to these shipyards: General Dynamics' Electric Boat at Groton, Conn. (2); the Newport News, Va. Shipbuilding and Drydock (2), and the Naval Shipyard at Mare Island, Calif. (1). The Navy also launched a seventh *Polaris* sub—the Sam Houston.

Centaur Launch Slips

First launch of a *Centaur* vehicle is expected to slip into the third quarter of this year as a result of an engine explosion at Pratt & Whitney's West Palm Beach, Fla., plant in mid-January. Shot had been scheduled for June 29. The explosion occurred when one engine failed to ignite and an excess of LH_2 and LOX was pumped into the chamber.

NASA Tests Weightless LH_2

Data on heat transfer coefficients for liquid hydrogen during 5 minutes of weightlessness was obtained by NASA Feb. 5 in the 94-mile high shot of an *Aerobee 150A* from Wallops Island, Va. The 25-lb. payload contained a dewar partially filled with the liquid. Telemetry was successful but weather prevented payload recovery.

Germans Leave Space Club

The budding European space program suffered a devastating blow last week when the West German Defense Ministry announced that Germany would not participate in such a program.

Drafters of the plan had counted on the West Germans for 18% of the estimated cost of $200 million (M/R, Feb. 6, p. 15). Great Britain, in addition to the money already spent in developing the *Blue Streak* rocket, would put up 25%, France 22%. Italy was to supply 11% and other countries less than 5% each.

Informed sources indicated that Belgium, Austria and Denmark—whose support during the Strasbourg conference was never overly enthusiastic, may follow the German lead and stay out of the joint effort.

Capsule Weight Hush-Hush

The National Aeronautics and Space Administration declined last week to release the total weight or a breakdown of component weights in the *Mercury* capsule.

Warren North, chief of manned satellites in the manned flight section of NASA headquarters, said the Air Force objects to release of the total weight on the ground that it reflects the capability of the *Atlas*—and thus the size of its warhead.

In addition, he said, the weight information would reflect the state of the art in manned capsule design.

NASA spokesmen have said the capsule weighs slightly more than a ton. North declined to go beyond that statement.

He said that contractors with security clearance and the need to know—such as for study contracts on *Apollo*—could have the weight information on a classified basis.

ON ONE OF HIS FREQUENT visits to industry facilities, West Coast Editor Richard van Osten confers with Aerojet-General's director of testing operations.

memo from the publisher

THE MAN at the left above is Dan Tenenbaum, manager of Aerojet-General's test division at Sacramento, Calif. The serious-looking gentleman on the right is a former intelligence officer who now heads up our West Coast bureau. With apologies to Dan, this is about Dick.

As many of you already know, Dick van Osten is well qualified in the missile/space field as a replacement for Bill Coughlin, who moved East to the editor's desk. Dick has been covering the industry as a member of the Los Angeles staff for the past four years.

His assignments have taken him not only to Sacramento, where the picture above was taken, but north to Boeing, south to Convair and west to military installations in Hawaii. One of Dick's most recent articles was the exclusive on optical alinement of the mobile *Minuteman* guidance package which appeared last week. You'll find his story on the IRE Winter Military Electronics meeting on p. 42 of this issue.

Van Osten was an Air Force pilot from 1943 to 1949. Much of this time he spent flying C-47's in Europe, where he met the charming Belgian girl who is now his wife. They have two children. Dick also was an instructor at the European Command Intelligence School in Oberammergau, Germany.

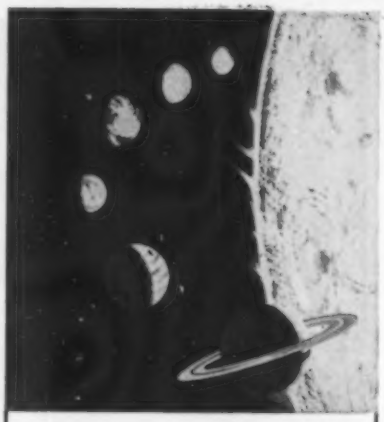
Before World War II, he worked at Douglas Aircraft Co. in the experimental department, in final assembly and as a flight line mechanic. One of his more interesting jobs after the war was on the fabled Hughes flying boat, where Howard Hughes once stepped on his hand. Van Osten later was editor of an automotive publication at Trend, Inc., now Peterson Publications. During this period, his love of race driving was combined with his knowledge of Europe in a fine series of exclusive articles from Le Mans and other racing centers on that side of the Atlantic.

Just before joining us at American Aviation Publications, Dick worked for Lockheed Field Service in California and for Frank Mayer Engineering Co. as a technical writer.

Incidentally, while Dick was busy in Los Angeles at IRE, one of his staff members, Associate Editor Frank G. McGuire, was in Salt Lake City covering the American Rocket Society solid propulsion meeting. His story is on p. 35. This kind of on-the-spot coverage enables us to bring you the important technical news of the missile/space industry as it happens, coverage valuable to you in your job.

Your appreciation of this is shown by the fact that our circulation hit an all-time high of 31,027 paid subscriptions for the January 30 issue—up some 2000 in the last six months. It also has been reflected in an all-time high in advertising billings for January issues.

Edwin S. Michelfeld



STRUCTURAL RESEARCH

The expanding and aggressive role we are taking in our nation's developing space program has created a demand for senior engineers and scientists with an innate curiosity about, and an intense interest in, any of the yet unexplored technological areas requiring solution. One example is the structural design and analysis of spacecraft. Some random samples of our current requirements are:

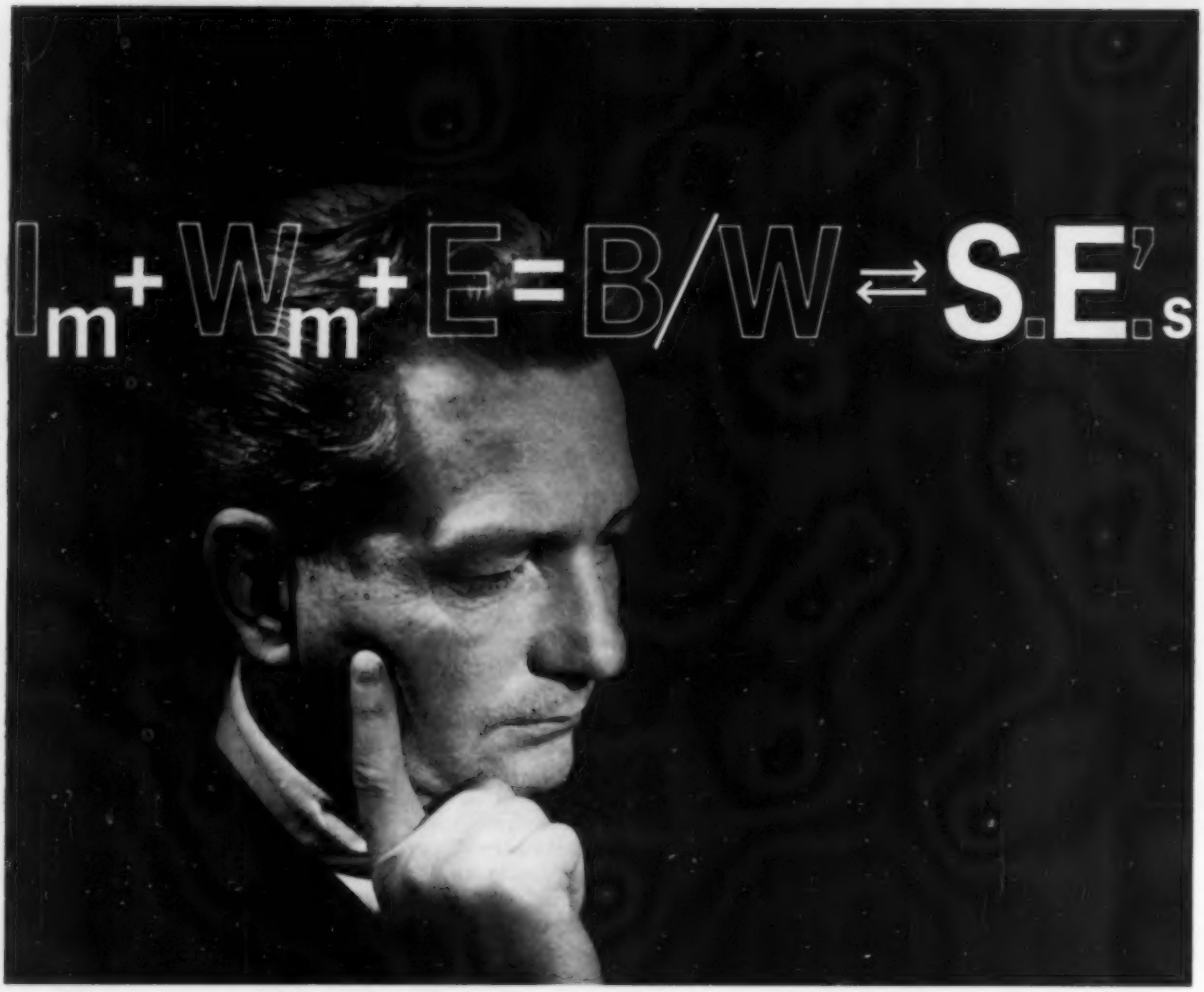
Senior structural research engineers or specialists with experience in structural research in areas of plasticity and viscoelasticity, thermo-stress of re-entry vehicles, internal heating and joint conduction dynamic buckling, creep and fatigue, etc.

Experienced structural dynamics engineers to work in areas of vibration and flutter, aeroelasticity, dynamic loads, fuel sloshing and generalized dynamic analysis of spacecraft.

If you are a graduate Aeronautical, Mechanical or Applied Mechanics engineer with five or more years experience in structures, and wish to broaden your experience and brighten your future, address your resume to:

M. R. Cunningham, Manager
Employment Services
12214 Lakewood Blvd.
Downey, California

SPACE AND INFORMATION SYSTEMS DIVISION
North American Aviation



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To pinpoint it further, we have immediate requirements for Structural Engineers with experience in design adapted to high performance; Dynamics Engineers to work on theoretical flutter and loads analysis; Weights Engineers to maintain close control of airplane limits and tolerances on weight and balance; and Stress Engineers to conduct research on load, stress, and fatigue analysis.

If you would like complete details about working facilities, company benefits, and living conditions in Wichita, write Mr. Melvin Vobach, Dept. **F 22**, Boeing Airplane Company, Wichita 1, Kansas. He will answer you promptly, and in complete confidence.

Boeing/Wichita also needs Design, Test, and Research Engineers in aerodynamics, electrical-electronics, and flight test. If you're qualified in one of these categories, write Mr. Vobach for details.

BOEING/WICHITA

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The Countdown

WASHINGTON

ICBM Base Speed-up Coming

Every possible means of accelerating construction of *Atlas* and *Titan* bases is being examined by the Kennedy Administration. The goal is to make up lost time and to at least tie, if not beat the old schedule. More rapid deployment of *Minuteman* is considered a strong possibility—although the first launchers have not been started yet.

Anti-Tank Missile Shelved

The Army decision for procurement of large numbers of anti-tank missiles is being left, at least temporarily, on the shelf where it has been for the last several months. One contractor in the hot competition has already been recommended by Army evaluators. But the recommendation remains stopped in the Chief of Staff's Office.

Budget Changes: How Many and How Much?

About $2 billion in add-ons to the final Eisenhower defense budget is the figure now expected by many Pentagon insiders. As many as 30 programs may be affected. However, the bulk of the money is expected to go to the big strategic missiles systems and Army modernization.

$110 Million for Navy Ranges

The Navy is scheduled to spend about $100 million in FY '62 on the sprawling Pacific Missile Range. Another $10 million of Navy money is earmarked in the new fiscal year for initial work on AUTEC—the Atlantic Underwater Test and Evaluation Center which will be built in the Bahamas. In all, some 15% of the Navy's R&D budget will be spent on the two ranges.

Lunar Orbit Stalled

Next attempt at a lunar orbit by the U.S. now appears to be at least two years away. It apparently will be with the *Surveyor* spacecraft being developed for NASA by Hughes for first flight in 1963. Lunar orbit will be an offshoot of the program to soft-land an instrument package on the moon.

On the Pad

NASA is re-examining its launch schedule. Prime questions concern first flight of *Saturn*, which has slipped a little but may still go in the third quarter of this year, and whether to aim for a launch toward Venus with *Mariner* in August, 1962. . . . Repeat attempt of a *Scout* satellite is expected within a few days. Vehicle carrying an *S-56* air-density drag 12-ft. balloon will have a beacon antenna on the fourth stage. . . . A *Little Joe Mercury* is set for about March 1.

INDUSTRY

New Solid Propellant

North American's Rocketdyne Division has come up with an advanced flexible-cast propellant which it considers a major breakthrough. Called Flexadyne, the perchlorate aluminized propellant is said to offer 100% improvement in elongation and tear resistance.

Countermeasure Competition

Some of the hottest company competitions now under way concern Air Force proposals for missile countermeasures. One of the bigger ones is understood to involve a $100 million contract. Several electronic companies have lines up into teams to get in on the bidding.

R&D Intelligence

Latest *Nike-Zeus* shot aborted after the first-stage head burned through. Score now: 8 successes, 3 partials, 3 failures. . . . *Nerva* is the new name for flight version of nuclear rockets developed under NASA-AEC Project *Rover*; non-flight models will still be called *Kiwi* . . . Chrysler is the fourth company in the *Saturn* booster tank competition (see p. 31) . . . AF is holding conferences on problem of monitoring critical hotspots on *Dyna-Soar*. Astronauts may use a fibre optics system. . . . An aircraft-controlled undersea vehicle capable of spotting enemy submarines and mines is now under advanced development.

Commercial Satellite

Cook Electric is getting ready to market a commercial launch vehicle capable of placing a 100-lb. payload into a 200-mile orbit. Components are said to be off-the-shelf.

Nova: $10 Billion

Latest estimate for developing the multi-meg thrust *Nova* booster is now put at $10 billion. Any decision to get the project going would entail a major commitment of available space funds. Hence, none is expected without a searching reappraisal by the Kennedy Administration.

INTERNATIONAL

New Space Combine

In a perhaps premature move, eight major British industrial concerns have set up a brand-new British Space Development Co. to exploit the commercial uses of space. The company was formed in anticipation of the European Space Club becoming reality. Hopes for this international joint venture now seem doomed with the withdrawal of support by West Germany. Still, the new British combine is significant in that it is the first broad attack by private capital to venture into space. Participants include: Associated Electrical Industries, Associated Television, British Insulated Callenders Cables, Decca Radar, de Havilland, Pye, Rank Organization and Rolls-Royce.

Overseas Pipeline

India is said to be in the market for *Sidewinders* and British *Bloodhound* missiles. . . . Norwegian Army personnel have fired *Honest John* missiles successfully in field trials. . . . An official West German military journal, "Bundeswehr," says Russia now has 10 permanent ICBM bases equipped with 5000-mile birds on launchers.

Second source possible . . .

Hike in Minuteman Output?

Production rate could be raised 50-100% to speed deployment—may create industry problems. First silo shot is still set for summer as Air Force moves ahead with instrumentation. Elaborate electrical grounding needed to prevent radio interference of remotely operated launch equipment poses unique problem

by Hal Gettings

CAPE CANAVERAL—The Defense Department is considering ordering a 50-100% increase in the *Minuteman* production rate to speed ICBM deployment.

Approval of the proposal could affect the present contracting setup headed by Boeing Airplane Co. There is one report that the Air Force may create a duplicate contractor team to second-source the entire *Minuteman* system.

Any decision to increase *Minuteman* production greatly would have to be made within a few months—to take maximum advantage of the time which could be saved in placing the big solid-fueled missiles in silo launchers. Bids are now being studied for contracts to build the first 150-launcher *Minuteman* complex at Malmstrom AFB, Mont. Construction had been scheduled to start late last year.

While a step-up in *Minuteman* production is one of the major items in the current DOD review of U.S. strategic forces, no speed-up is presently planned in the first full-scale silo shot from Cape Canaveral—despite the success of its first flight test (M/R, Feb. 6, p. 14.)

Silo launch facilities are on schedule and Ballistic Missile Division officers are confident that ground equipment will be installed well ahead of the first silo shot, scheduled for this summer.

Construction of one silo, complex 32, already is finished and instrumentation probably will start next month. The other silo is not far behind.

BMD made it clear, however, that project efforts will be devoted to seeing that the silo shot gets off on schedule rather than accelerating the schedule.

• **Handsome payoff**—In Los Angeles, Col. Sam Phillips, BMD *Minuteman* program director, told MISSILES AND ROCKETS that all phases of tracking and instrumentation worked perfectly during the 4200-mile Feb. 1 research and development flight.

SUCCESSFUL Feb. 1 launching.

"Everything worked exactly as it had been designed to work," Col. Phillips said, adding that early study of telemetry results indicates "we're not due for any surprises."

"If there is any single thing that stands out above others in the test results," Phillips said, "it is our feeling that all our efforts in stressing reliability have paid off handsomely."

Engineers at Autonetics echoed this in their post-flight analysis of the guidance and control system. "This is not the end, just the beginning," one said.

The *Minuteman* shot was reported to have impacted well within the target area. Autonetics said the missile pitch action after liftoff, which caused some comment, was due to the guidance system, which puts the missile on trajectory "right now."

• **Minimum complexity**—Simplicity of the solid-fueled, 6300-mile *Minuteman* is reflected in the lack of clutter and elaborate equipment on the pad and in the operational-type silos.

Gantry and umbilical towers are simple and clean. The pad consists of a launching ring set over an uncomplicated blast deflector. Elimination of the complex liquid-fuel handling equipment is, of course, the key to the simplicity of the ground support equipment.

The silos are, at the surface, simply holes in the ground surrounded by concrete aprons. Electronic gear for both pads and silos is located in an underground room.

The R&D silos—essentially the same as those to be used in operational hardened sites, with the exception of the cover—are based on designs proved out in development tests at Edwards AFB, Calif.

Firing tubes, 12 ft. in diameter and made of reinforced concrete lined with steel, are surrounded by underground galleries within an outer concrete silo. Instrumentation, power and auxiliary equipment will be located in the galleries.

The R&D ground electronic equipment here at the Cape closely approximates the operational gear. After use in the first few launches, this will be replaced with an operational system.

There are no exhaust ports in the silo. A small concial spreader at the bottom of the tube will deflect the blast up and around the missile as it rises out of the tube. No skid bars or other mechanical devices are necessary to guide the 60-foot missile out of the hole; its own guidance system keeps it vertically centered as it emerges on launch.

A chute, aiming North and slanting down to the collimator bay near the

top of the tube, is used to provide optical sighting of the North Star *Polaris* to calibrate the missile's guidance system.

• **Underground electronics** — One unique feature of the silo construction is the elaborate electrical grounding network buried around the site. Radio interference problems with the sensitive instrumentation made this additional protection necessary.

The R&D ground electronic equipment, designed to be remotely operated during launch, is checked out, sealed and not reopened until after the launch —or until trouble develops. In operational deployment, the three-stage *Minuteman* will be lowered into the underground bomb-proof silo, checked out, tied into its communications and monitoring equipment, and then the lid will be closed. From then on, the missile is ready to go at a moment's notice.

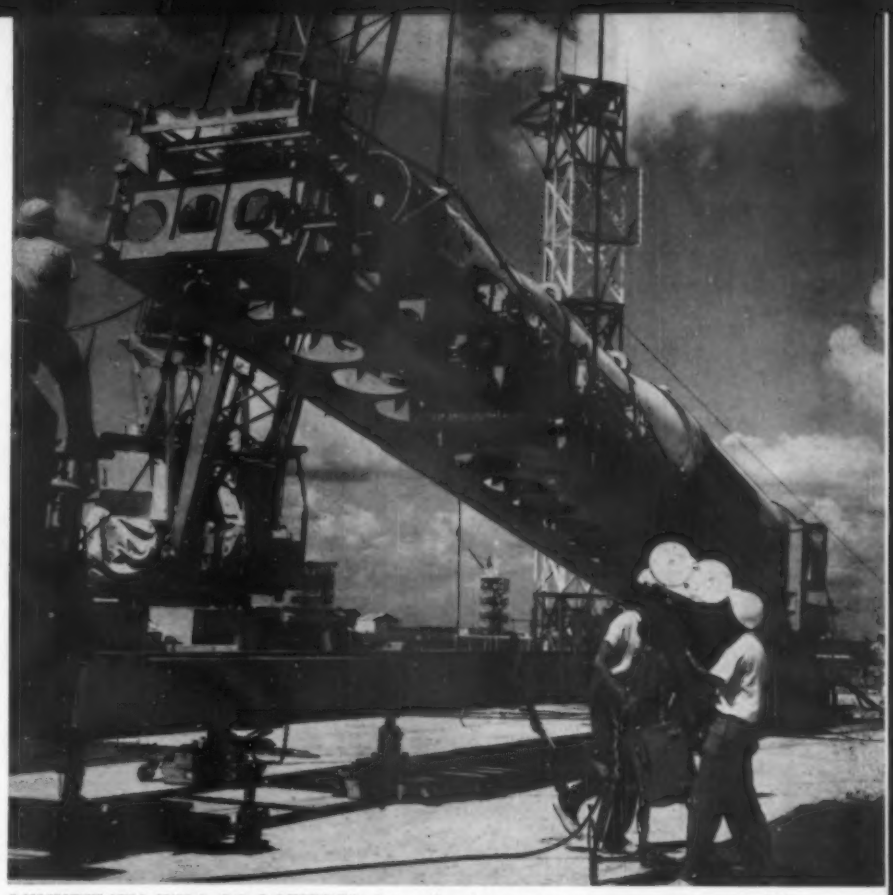
• **New depth for Florida**—The silos, built by the Army Corps of Engineers, represent several new and unusual construction techniques. The 90-ft.-deep structures—the deepest dry holes in Florida—were built practically under water, with attendant problems not encountered in conventional construction. In addition, the silo has to withstand the tremendous blast pressure of the missile launch—up to 3000 psi.

Each hole is 109 feet deep overall with a 12-ft.-thick seal of tremie concrete at the bottom covered by a 7-ft. layer of reinforced concrete. The sides of each silo were designed to a thickness of three feet with an inner diameter of 26 feet. This thickness was changed to four feet for the added weight necessary to keep the structure from floating. Each silo weighs about 4000 tons and contains more than 100 tons of steel reinforcing.

Work on the silos was started in July, 1959, by the Dravo Corp. The caisson sections were precast above ground. The first caisson—roughly 14 feet high—was placed on top of a triangular cutting shoe made of half-inch steel plate. This section was sunk into the sandy soil by its own weight.

On top of each caisson, construction joints were formed to provide horizontal shear keys with the vertical rods in the reinforcing steel mats serving as dowels. In addition, a 12-in. rubber water stop was cast in the concrete at each caisson joint.

After the first caisson was sunk, precast topping caissons 20 feet high were lifted into place. A curing compound made of a crude liquid floor wax was applied to the outside surface of each caisson to retain moisture in the concrete and lubricate the outside surface to reduce skin friction during the sinking operation.



MINUTEMEN WILL BE LOWERED into silos by same transporter-erector used in handling surface-launch missiles. Missile shown here is a test model.

• **Even sinking**—As the caissons sank under their own weight, the waterlogged soil inside the silos was removed around the cutting shoe to allow even sinking. The water level inside the caissons was kept at the same level as the ground water level outside to equalize the hydraulic head.

When the caissons were sunk to about 80% of the completed depth, friction overcame their weight and the sinking stopped. To continue the sinking, well points—spaced 18 inches apart around the caisson circumference —were sunk to the edge of the cutting shoe. Compressed air, controlled by valves to each group of points, was fed into the lines in spurts at 150 psi. These air jets eased the pressure on the cutting edges, reduced the friction, and aided the sinking process.

After the final caisson was sunk, the tremie concrete seal or plug, 14 feet thick, was poured. Since the silos were full of water, a water-tight steel pipe was fabricated to extend from a platform suspended a few feet above the top of the silos to the bottom. The tremie concrete was fed into a hopper on top of the platform.

After the pour was completed, the plugs were allowed to cure out for two weeks before the silos were pumped dry. When the pumping was completed, the top surface of tremie seal was cleaned and scarified to receive the structural concrete floor cover seven feet thick. This floor was poured dry.

Specifications required that the center line of each silo be kept within a circle with a radius of one foot. The one farthest off the mark was found to be off by only 2⅜ inches. ⌗

West Coast Silo Started

Construction of the first Minuteman silo and launch facilities has begun at Vandenberg AFB, Calif., under a $2.5-million contract awarded Stolte Construction Co., Los Angeles.

Launch facilities will include rail spurs for mobile Minuteman emplacements.

The silos themselves are expected to be completed by late September; installation of ground support and operational equipment will follow. The complete facility will include two missile control centers, one above ground and one below, and one destruct package building. The latter will house materials used in test and training launches for range safety in event of missile malfunction.

Latest Reports Say Missile Gap Continues

Apparent conflict in varying stories may be caused by confusion of 'missile' and 'destruction' gaps

by James Baar

NEW U.S. INTELLIGENCE estimates—no more than a week old—are understood to report no change in the existence of a Missile Gap. Russia continues to hold about a 3-to-1 edge in ICBM's over the United States.

The estimates, made without benefit of U-2 overflights, are understood to be precisely the same as intelligence reports of a year or more. They show that if the current scheduled rate of deployment of U.S. missiles remains unchanged, a gap of at least 3-to-1 will continue through the early 1960's.

The life-or-death question is whether during this period the United States has enough bombers and other strategic weapons to prevent a "deterrent gap" or "destruction gap" from opening up as well.

These are the key factors that must be kept in mind in any evaluation of last week's contradictory reports on the Missile Gap.

• **Background**—These also are the factors that clearly were behind previous statements made by the two principal figures in the latest Missile Gap debate—President Kennedy and Defense Secretary McNamara.

Kennedy told Congress bluntly in his State of the Union Message:

"Each day we draw nearer the hour of maximum danger as weapons spread and hostile forces grow stronger . . . I have directed prompt action to accelerate our entire missile program."

Then he announced that he had directed McNamara to conduct the current complete review of the nation's defense strategy and forces, in order to decide what additional effort would be needed.

Only three days later McNamara told a news conference that he did not wish to comment on the Missile Gap because the studies which had begun about Jan. 20 had not been completed. However, later this exchange took place:

Q—"Mr. Secretary, General Eisenhower in his last State of the Union Message said that the Soviet bomber threat was fiction and the ICBM threat might prove to be the same. Is that one of the studies that you might be making . . .?"

McNamara—"I believe that the question was that President Eisenhower stated that the Soviet bomber threat and the Soviet missile threat was fiction. I wasn't aware that he said that. I don't believe it is . . ."

Q—"The President said that the gap, between the United States and Russia, insofar as bombers, had proven to be fiction."

McNamara—"As I mentioned earlier, I don't wish to comment on any gap. I am simply stating that I don't think it is fiction."

Four days later top Defense officials were reported with varying degrees of hardness to have concluded from their studies to date that no "destruction gap" exists today and that the number of ICBM's on either side is insignificant in the total military equation.

Some reports said the Missile Gap had been found not to have materialized so far and that it would not materialize. There were other variations.

• **Inevitable question**—The next day, Feb. 7, Presidential News Secretary Pierre Salinger said the reports that no Missile Gap had been found were inaccurate. And the following morning the President faced the inevitable question at a news conference.

Q—"Mr. President, in the past 24 hours there has arisen a somewhat hard to understand situation concerning the missile gap. An official of your Administration, who was identified in some newspapers this morning as Secretary McNamara, has been quoted as saying that the missile gap which was expected and talked about so much did not exist, nor did he see prospects of it.

"Your Press Secretary, yesterday afternoon, denied this story. Now, I wonder if you can set the record clear, if you can tell us your version of what Secretary McNamara said, and what your feelings are about the missile gap. Does it exist, and how and where does it exist?"

THE PRESIDENT: "My only conversation with Mr. McNamara was not at any off-the-record meeting, if such a meeting took place, but was in a conversation which I had with him yesterday afternoon after the reports appeared.

"Mr. McNamara stated that no study had been concluded in the Defense Department which would lead to any conclusion at this time as to whether there is a missile gap or not. In addition, I talked this morning to Mr. Hitch, who is the Controller of the Defense Department, who has been given the responsibility by the Secretary of Defense to conduct a review of your strategic weapons, in the same way that Mr. Nitze is conducting a review of our tactical weapons. Mr. Hitch informed me that no study has been completed on this matter.

"He hoped to have a preliminary study completed by February 20th, but he did tell me quite specifically that as of today he is not prepared to make a judgement as to our capacity in strategic weapons.

"There are complicated problems involved. We have the realization that the United States will not strike first, and, therefore, we have to consider what will be available to the United States if an attack took place upon us, not only in missiles, but in the other arms of our arsenal, SAC, the Navy, *Polaris*, and all the rest.

"So I think in answer to your question, the study has not been completed, and it has not come, therefore, across my desk. There will be a study of how the budget for fiscal 1961 and 1962 should be changed in view of our strategic position, but that study will not be completed by either Mr. Nitze or Mr. Hitch, or come across Mr. McNamara's desk to be passed to me for some days."

• **Much ado on Hill**—Meantime, Congress reacted loudly.

House Republicans demanded that Kennedy apologize to Eisenhower for what they called "slander" by Democrats who had charged there was a Missile Gap. Rep. Thomas M. Pelly (R-Wash.) sarcastically praised the Kennedy Administration for ending the Missile Gap in "just 18 days."

Sen. Prescott Bush (R-Conn.), a member of the Senate Armed Services Committee, called for an investigation. Later, Chairman Richard Russell of the Armed Services Committee said he would call for beginning the committee's annual "military posture" hearings Feb. 20.

Thus, the committee will meet just in time to hear the results of the Administration studies. At that time, the Administration will have to disclose how it plans to meet the Missile Gap that continues to be reported by U.S. intelligence sources. ⌗

Re-entry trouble?

Soviets Set New Weightlift Record

THE RUSSIANS were one-up in space again this week with the launching of 7.1-ton *Sputnik VII*, heaviest object yet placed in orbit. The Feb. 4 launch came just four days after the U.S. sent a chimpanzee soaring 420 miles down the Atlantic Missile Range aboard Mercury Redstone 2.

With America's first manned ballistic space flight perhaps less than 60 days off, the Russians said their new satellite was a "step forward" in their manned space flight program.

The Soviet Union gave out few details on *Sputnik VII* and did not state whether an animal or man was aboard. The official announcement by Tass news agency gave the perigee as 138.5 miles, apogee as 203.5 miles. Orbital inclination was 64° 57′ and period 89.9.′

President Kennedy said at his news conference last week: "We have no evidence that there was a man in the rocket." The White House disclosed that the President had been informed of the Soviet launching by U.S. "Intelligence sources" prior to the Moscow announcement. These presumably were electronic tracking stations.

But use of the unusual phrase "intelligence sources" raised some speculation that *Samos II*, the new U.S. spy satellite, might have played a role in the detection of the launching. A research and development model of *Samos* was launched into polar orbit with high-resolution camera equipment on Jan. 31. The Air Force refused to comment on this possibility.

• **Propulsion prowess**—Weight of *Sputnik VII* was taken as an indication of improved Soviet launch capability. Tass referred to an "improved multistage rocket" as the launch vehicle.

A Czechoslovakian technical publication reported that a new heat-resistant alloy of high strength and low specific gravity is now employed in rocket engines in the USSR. It said these engines develop thrusts of 1-million kg. (2.2 million lbs.)

If the report is accurate, the Soviet Union is even further ahead of the U.S. in this field than previously suspected.

Some U.S. propulsion experts expressed doubt that a new rocket was needed. They pointed out that a payload increase also can be attained with a lower orbit or by use of better guidance.

Russian Satellite Launchings

Name	Launch Date	Perigee-Apogee	Status
Sputnik I	Oct. 4, 1957	142-588 miles	Down Jan. 4, 1958 (92 days)
Sputnik II	Nov. 3, 1957	140-1038	Down Apr. 4, 1958 (162 days)
Sputnik III	May 25, 1958	105-328	Down Apr. 6, 1960 (692 days)
Lunik I	Jan. 2, 1959	Around sun on 15-mo. period	In orbit, est. life millions of years
Lunik II	Sept. 12, 1959	Traveled 236,875 mi.	Impacted on moon Sept. 13
Lunik III	Oct. 4, 1959	24,840-292,000	Down Apr. 20, 1960 (199 days)
Sputnik IV	May 15, 1960	174.7-359.8	In orbit
Sputnik V	Aug. 19, 1960	189-210	Down Aug. 20, 1960
Sputnik VI	Dec. 1, 1960	106-146	Down Dec. 2, 1960
Sputnik VII	Feb. 4, 1961	138.5-203.5	Expected short life

Possibility of an up-rated upper stage or an additional stage was not ruled out. But experts here doubted the Russians would develop an entirely new booster to obtain only a 40% increase in payload. The jump would be even bigger than that, they guessed.

• **Tracking reports**—The North American Air Defense Command NORAD was among the first to confirm the *Sputnik VII* orbits. NORAD's monitoring stations traced the object through six orbits while it was transmitting signals. NORAD recently took over direction of the Navy's space surveillance system.

From New York, the Radio Corporation of America reported on Feb. 5 no success in picking up any radio trace of the satellite. The same report came from the Astro Observation Station of the Army Signal Research and Development Laboratory at Fort Monmouth, N.J.

The Air Force National Space Surveillance Control Center at Bedford, Mass., disclosed it was tracking the Soviet satellite but declined to release any information on the grounds that it had no assigned mission regarding the *Sputnik*.

National Aeronautics and Space Administration's Goddard Space Flight Center reported it had not been able to detect any radio signals from the Russian satellite and was unable to track it.

Silence from the satellite after launch was regarded by a number of U.S. space officials as indication of a power failure. It was believed that the primary purpose of the satellite was data gathering. This was supported by the fact that most Soviet comment on it came from Russian cosmic ray, ionospheric and micrometeorite experts.

• **Russian comment**—Prof. Ivan Shevlyakov of Moscow Planetarium called the shot "a leap in the creation of rockets for space travel." Tass referred to the satellite as a *Sputnik*, not a space ship. The latter designation apparently is a propaganda term for satellites which have carried animals.

Tass, for example, referred to the new shot as *Sputnik V*. But a wire from Moscow to the Scottish Royal Observatory later in the week properly referred to it as *Sputnik VII*.

Shevlyakov said the low perigee of the satellite would result in its burning up in the atmosphere within a few days after launch. Some Western experts raised the question of whether the Russians were continuing to have difficulty with re-entry problems, already solved by the U.S.

Tass gave the weight of the satellite as 6483 kilograms or 14,292 lbs.

In terms of the U.S. short ton of 2,000 lbs., the object weighed 7.1 tons. By Soviet metric standards, it weighed 6.48 metric tons.

Announced weight did not include the last stage of the multi-stage launching rocket, according to Tass.

Speculation that the Russians might have placed a man aboard the satellite arose when observatory scientists at Bochum, Germany, reported picking up what might have been Russian Words in Morse code from space.

The report followed claims by two "ham" radio operators in Turin, Italy, that they had picked up what sounded like "moaning or heavy breathing" from space. The reports from both Germany and Italy were made before Moscow announced the launch. ⌗

At Senate urging . . .

Overhaul Coming in Procurement Rules

But Pentagon will go slow in making any changes in contract cost principles; nine steps planned

THE PENTAGON has told Congress that it will revise its procurement rules in line with a Senate Armed Services Committee recommendation.

But Capt. J. M. Malloy, chairman of the Armed Services Procurement Regulation Committee, says that any changes in contract cost principles—Section XV of the ASPR—will be ground exceedingly small before they are incorporated.

The proposed change, permitting a contract officer to reduce target cost where price was based on inaccurate or out-of-date cost data, is one of nine steps the Pentagon says it is taking to improve procurement techniques as recommended last year by the committee.

The proposal calls for an adjustment provision in all negotiated fixed price contracts over $100,000, unless the contract price is based mainly on price competition or established catalogue prices. It would permit the contracting officer to "equitably reduce the contract price if he determines that the cost was overstated because any contractor or first-tier subcontractor failed to disclose any significant and reasonably available cost data or furnished any data he knew or reasonably should have known was false and misleading."

DOD said it will also revise the Armed Services Procurement Regulations to require solicitation from the maximum number of offerers "consistent with the nature of and requirements for the supplies and services to be procured, in accordance with the basic policies set forth in Section 1, part 3, to the end that the procurement will be made to the best advantage of the government, price and other factors considered."

In line with the committee's recommendation for "more specific determinations and findings," DOD said it will change the rules to read: "Each determination and finding prepared in accordance with departmental procedures shall set out enough facts and circumstances to justify clearly the specific determination made. Each determination and finding for authority to negotiate either an individual contract or a class of contracts shall clearly indicate that the use of formal advertising would be impracticable and the reasons therefore."

DOD said it had also taken steps to develop adequate contract specifications and that it is continuing to encourage prime contractors to use the Department of Commerce synopsis to publicize opportunities in the field of subcontracting stemming from their defense business.

Capt. Malloy spoke to a group of about 500 industry representatives at the recent National Security Industrial Association Seminar on DOD procurement.

Malloy pointed out that current cost principles—revised just a little over a year ago after several years of study—deal with broad policy and that there is no "neat package" solution to all costing problems. "Everyone," he said, "wants these neat packages when it suits his own particular approach, but I am rather certain . . . of the fallacy of this approach."

Malloy took a dig at industry for objecting to the degree of specificity and detail incorporated during the development of the cost principles. Now, he says, industry representatives are complaining that the regulation is not specific enough. On one hand, he said, industry argues for general policy guidelines and, on the other, it seeks specificity as a protection against contracting officer interpretations.

• **Where changes may come**—Malloy noted these items under study aimed at possible changes or additions to ASPR cost principles:

–Cost principles applicable to acquisition of facilities and to construction contracts. These, which will appear in parts 4 and 5, are now in draft

Renegotiation Bill

Legislation has been introduced to give the General Accounting Office authority to review negotiated government contracts.

Sen. John Sparkman (D-Ala.), chairman of the Senate Small Business Committee, said that present procurement regulations permit the use of negotiation when "procurement could be formally advertised." The new authority would be identical to authority GAO presently has to examine advertised procurements and could amount to advance screening of all negotiated defense contracts.

Sparkman said that "When contracts are advertised openly instead of negotiated, small firms have a much better opportunity to sell their goods and services to the government." The new legislation, he claimed, would authorize GAO to question only those decisions to negotiate that are "clearly erroneous, arbitrary or capricious, or not supported by substantial evidence."

form and available for review and comment by industry associations.

–Cost principles applicable to research contracts with educational institutions (part 3). Being revised to reflect changes directed by Bureau of Budget.

–Cost interpretations. Establishment of new part 7 to contain so-called cost interpretations is being seriously considered by the committee, but problems are many. Such an addition might include additional guidelines as to reasonableness or allocability in connection with a particular cost item.

–Location allowances. Revision 3, published on Jan. 31, will be aimed at eliminating abuses of location allowances or incentive pay and define more strictly criteria for recognition.

–Recruiting expenses. High costs of recruiting to continue to get hard look although no changes are contemplated at present.

–Advertising. Basic study being undertaken to amplify and clarify general terms of present cost principles. No predication as to outcome.

–Development expense. Study underway to determine whether independent development expense can be allocated to all work of a contractor in the contract product line (including R&D) or only to production contracts.

–Personal property taxes. Tentative view is that state taxes on defense material, when significant, should be handled as direct cost. Method of implementing is under study and could result in change in cost principles and to standard tax clauses as well.

–Interplant material transfer. In spite of some industry agitation for liberalization of cost principle concerned with charges for material transferred between plants or divisions under common control, no basic changes are contemplated. Present ASPR coverage represents liberalization over previous treatment and is a compromise between industry and government positions.

–Bidding expense. DOD takes dim view of R&D effort expended and charged off for elaborate unsolicited proposals. Additional restrictions are threatened if "needless costs" in this area are not cut down.

In addition to Malloy, an imposing list of speakers and panel members—top-level military and industry procurement and contracts specialists—appeared in the two-day seminar. The subject of DOD procurement regulations and their administration was thoroughly covered in what was perhaps the most comprehensive treatment ever given the subject in open meeting. ⌗

AF Savings

Contractors Report Cuts of Half-billion

Evidence of cost savings of more than a half-billion dollars by Air Force contractors is being presented to Congress during FY 1962 budget hearings.

In an effort to dissuade Congress from another across-the-board slash in defense procurement appropriations, the 28 Air Force contractors will show how they cut $570.9 million in costs by streamlining methods.

The companies listed savings in these categories: general cost-reduction programs, $373.9 million; better purchasing procedures, $36.8 million; value engineering, $28.6 million; reorganization and consolidation, $5.9 million; facilities modernization, $1.7 million; labor savings, $10.3 million; overhead costs reduced, $29.7 million; better plant methods, $13.7 million; reduction of inventories, $3.3 million; use of electronic data processing, $1.3 million; cooperation among industries, $65.7 million.

The listing came in answer to a letter by Lt. Gen. Mark E. Bradley, AF deputy chief of staff (materiel) to principal contractors. The dollar total doesn't include savings effected by subcontractors, reductions related to improved management methods—or other intangibles not readily measured.

Air Force materiel chiefs feel they have a good case to present to Congress to forestall budget reductions in procurement. Similar programs in the Navy and Army will attempt to avoid arbitrary procurement cuts as disciplinary measures against careless spending. ⌗

Uhl Chosen to Head Fairchild Corporation

Edward G. Uhl, recently vice president and San Diego Division manager of Ryan Aeronautical Co., has been elected president of Fairchild Engine & Airplane Corp., Hagerstown, Md.

He will replace Sherman Fairchild, board chairman, as executive officer effective Feb. 20. Fairchild became acting executive officer last Oct. 5 following the resignation of J. H. Carmichael. Since then he has directed a reorganization of the company, including the appointment of J. T. Dresher as vice president-finance and John L. Grapper as secretary.

Uhl began his business career at The Martin Co. in 1946, and was successively a research engineer, project engineer, section head, chief project engineer, VP-chief engineer and VP-general manager, the last being at the Orlando, Fla., division of Martin. As VP-general manager at Orlando, he administered an organization that grew in 28 months to 6700 employees and had a backlog of $175 million in five major missile/space projects.

He joined Ryan in July, 1959, as VP-technical administration, San Diego.

Zeus Production Gets New Backing

Congress is giving strong new support to the Army's bid to begin production of the Nike-Zeus antimissile missile.

At the same time, the Kennedy Administration is actively considering a proposal to start producing the big missile system on an interim basis.

The so-called interim plan recommended late last year by a special Ad Hoc Committee (M/R, Jan. 30) would obligate about $270 million over the next 17 months, if production was ordered immediately.

Rep. George Mahon (D-Tex.), chairman of the House Defense Appropriations Subcommittee, indicated that he would favor an Administration request to begin the "interim plan."

On the floor of both the Senate and the House, Zeus received far more outspoken support.

Sen. Strom Thurmond (D-S.C.), a member of the Senate Armed Services Committee, said "we must start production of the Nike-Zeus now," and called for giving the Army the necessary money and authority.

"Further delay increases our risk. We can no longer run the risk of being half safe. I am convinced from the development tests of the components to date that the Nike-Zeus can provide the defense this nation needs to meet and master the intercontinental ballistic missile threat."

Rep. George P. Miller (D-Calif.), a member of the House Space Committee, told the House that "The United States will struggle in a straitjacket if it does not parallel its retaliatory ICBM with an antimissile missile defensive weapon system against the ballistic blackmail of the Soviet Union."

Miller said "the answer is Nike-Zeus—both as a missile killer and a satellite killer."

"The starting of production of the Nike-Zeus immediately will buy the precious time that we need," he said.

G.E. Wins Delayed Contest For Primer Nimbus Contract

GENERAL ELECTRIC'S Missile and Space Vehicle Division will head a team of contractors that will develop the *Nimbus* advanced weather satellite for flight by late 1962.

Selection of GE for prime and control and stabilization subsystems contracts totaling $4½ million ended a procurement delay that will cause about six months' slippage in the first launching, previously scheduled for the second quarter of 1962.

The National Aeronautics and Space Administration on Feb. 3, also announced these subsystem contractors, chosen earlier but kept secret: RCA Astro-Electronics, cameras and solar power systems; IT&T Laboratories, infrared equipment; Santa Barbara Research Center, infrared equipment; Radiation Inc., telemetry system; California Computer, command system.

The initial contract calls for flight of two satellites, lifted by *Thor-Agena B* boosters into 600-mile circular 80°-inclined orbits down the Pacific Missile Range. However, later versions of *Nimbus* are to be the eventual operational weather satellite of which many launchings are planned.

Nimbus weighs about 650 lbs., compared with about 280 lbs. for the *Tiros* series. Other differences:

–Its television cameras point permanently toward the earth. *Tiros* is spin-stabilized.

–Its near polar orbit will allow coverage of the entire globe. *Tiros* covered only areas between the 50° circles of latitude.

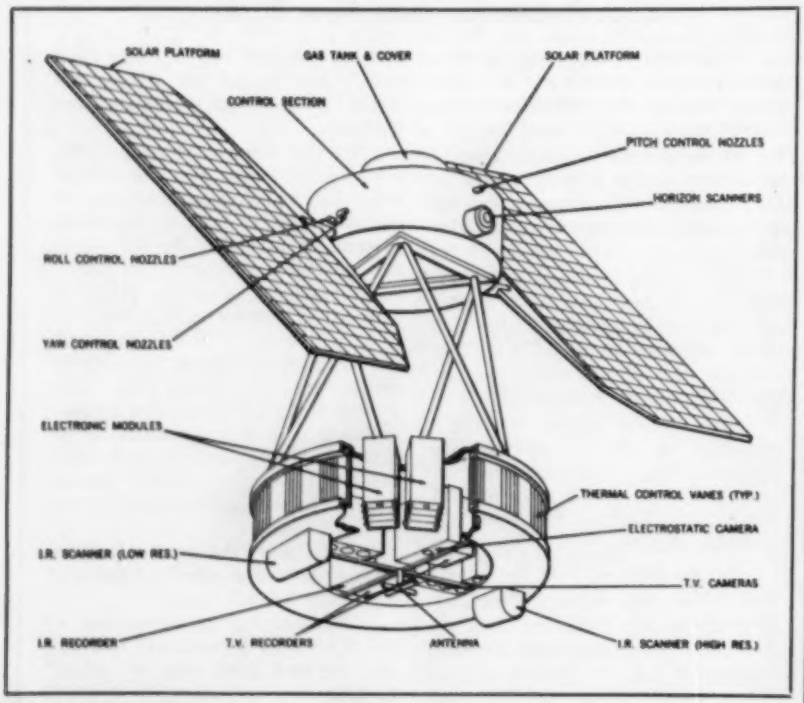
–It has six television cameras, compared with two for *Tiros*.

NASA's Goddard Space Flight Center is negotiating details of the prime contract and will manage it. GE was chosen from six bidders. The others were Temco, RCA, Grumman, Bendix and Republic Aviation.

Solar cells on two large paddles and storage batteries will provide power.

Gas jets and inertia wheels for fine control will rotate the spacecraft every 108 minutes—its orbital period—to keep it pointed toward the earth. Thus the effective life will be limited by the amount of gas available for the stabilization jets.

Cloud-cover pictures and other data will be played back by command from a primary data-acquisition site at Fairbanks, Alaska. The U.S. Weather Bureau and the Department of Defense will analyze all data and make meteorological information available to foreign scientists. ⠿



NASA SCHEMATIC of Nimbus satellite

Amcel

a flexible, dynamic approach to propulsion and ordnance

Amcel is an organization of specialists and special facilities, dedicated to second generation exploration and innovation in the fields of propellants, explosives, and related technologies. It is fully staffed and equipped for independent and contracted research and development programs, and pilot production.

Amcel facilities offer the efficiency of complete integration—a 1300-acre site that accommodates laboratories, static and flight test range, manufacturing and administration. This close departmental liaison helps to shorten lead time between concept and delivery.

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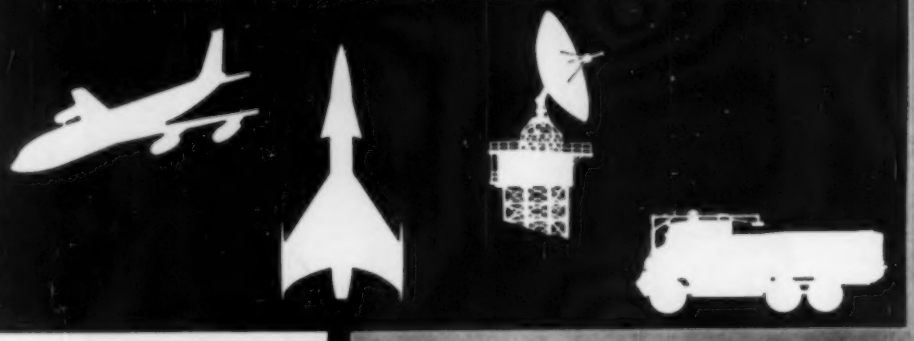

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Technical Countdown

ELECTRONICS

Peltier Cooling Advanced

Hughes Aircraft has developed a new material fabricating technique permitting thermoelectric coolers to operate at one-tenth the power normally required. Its heating efficiency is up to eight times as high as that of conventional resistance heaters, Hughes says. A three-unit, cascaded Peltier cooler has been used experimentally for infrared detector cooling to –100°F and drawing but 2 amperes of current.

Transistor Power to be Lowered

Taking another approach to electronics cooling, CBS Laboratories has embarked on a program for the Army Signal Corps to reduce existing circuit heat problems by vastly decreasing transistor power requirements. Specifically, the Lab will try to develop a silicon switching transistor for computer use that will require "several hundred times less power than conventional transistors."

Improved Memory Produced

A low-cost, light-controlled computer memory device has been developed for the Navy by scientists at New York University. Exploiting the phenomenon of persistent internal polarization, data can be impressed on a polarized solid-state plate by a small voltage and a beam of light, stored, and released again by a light beam. The plate employs a thin phosphor photoconductive layer. Both storing and access time are in "fractions of a microsecond," according to the Navy; and data density is much higher than with conventional memory devices.

New Fuzing and Arming Approach?

Tempo Instrument Inc. reportedly has developed the first solid-state arming and fuzing device. No details are available yet, except that the unit is believed to be entirely non-mechanical, employing no moving parts. Such a device could offer a real step forward in reliability—and this in a field that almost invented the word.

SUPPORT EQUIPMENT

NAP-100 Now Under Test

A new, 40-lb., thermonuclear electric-power generator, built by Westinghouse, is undergoing test operation at the Air Force's ARDC Special Weapons Center in Albuquerque, N.M. The hat-box-size portable unit is designed to produce 150 watts continuously for up to 1 year of unattended service, the Air Force says. Called the NAP-100, the system uses radioactive isotopes (such as Curium 242) to provide a heat source of about 1000°F for 144 semiconductive elements. Extremities of elements are maintained at 300°F to obtain Peltier-effect direct energy conversion.

ABLE Ready for Field Use

Autonetics' ABLE, a portable north-determining artillery or missile orienter, has successfully passed its exams at Fort Huachuca and has been ordered into production. The unit is basically a gyrocompass capable of determining true north to under 30 seconds of arc standard deviation in just a few minutes time. The Army says ABLE requires no star reference, bench marks or other fixed aids.

Inflated Engine Handler Devised

Presray Corp., Pawling, N.Y., reports it has developed a pneumatic handling device for inserting and removing engines in the first stage of *Saturn*. The device, called Pneuma-Grip, is inserted inside the nozzle and throat area inflated, so that the only material touching the sensitive inner surface is air-pressure supported rubber.

ADVANCED MATERIALS

High-Temp Steel Seals Developed

Self-compensating alloy-steel seals have been developed by B. F. Goodrich Aviation Products for hydraulic systems operating in temperatures up to 530°F and under pressures up to 6000 psi. The concept is that of a blunt knife-edge with controllable unit load that can seal pressures while holding the load on the radial edge of the seal as low as possible, keeping the break-out force low.

B-70 Honeycomb-Density Reduced

Substantial weight savings throughout North American Aviations' B-70 bomber have been achieved with chemical milling techniques developed by U.S. Chemical Milling Corp. The process cuts down the density of the stainless-steel honeycomb core used extensively in the Mach 3 aircraft.

Prepregnated-Plastics Record Expected

President Kennedy's announced push in missile and aircraft production should increase sales of prepreg materials over the 1960 figure of $25 million. Prepregs are ready-to-mold combinations of resins and reinforcement; the missile industry is largely responsible for the spectacular increase in sales, which added up to a mere $1 million in 1956.

ASTRONAUTICS

Rebound to Last 10 Years

The rigidized 140-ft. balloon satellite being developed under NASA's Project *Rebound* is expected to have a useful life of about 10 years, compared with six months to a year for the *Echo* passive communications balloon. About a half-dozen will be launched in each of a series of firings with *Centaur* vehicles, the first in about two years.

Lunar Landing Scheme Revealed

Latest wrinkle in plans for a manned lunar landing is that a duplicate spacecraft would land a month previously, check itself out completely and radio back that it is in operable condition. NASA propulsion specialists figure that if the manned vehicle is damaged on landing, the astronaut can get out and walk to the other vehicle for the return to earth.

Atlas Control System De-Bugged

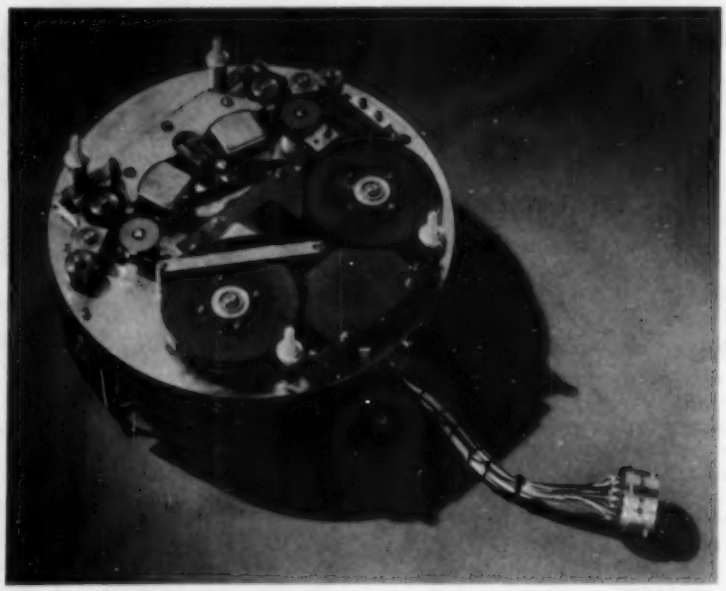
Problems plaguing the first three *Atlas-E* launchings are believed solved. The trouble was finally nailed down to the hydraulic control system. Earlier system improvements introduced new problems, but Convair now is looking confidently for a successful launch with No. 4 sometime this month.

New Breed of Recorders for Future

Raymond Engineering Lab's tiny tape units, slated for trips in S-16, Tiros and other satellites, could set standards for tomorrow

A FAMILY of new miniature FM tape recorders, embodying advanced mechanical design, may have set the criteria for future development of such instruments for space use.

Developed for a whole series of NASA's upcoming satellite programs, the units appear to have all the necessary ingredients for obtaining high quality orbital and probe data: small size and weight, very low power, low noise, exceptional flutter characteristics, and a minimum-friction design. Record-to-playback-speed ratios of up to 50:1 can be obtained with the recorder, its developers say.



ADVANCED DESIGN of Raymond's tiny 4-lb., 7-in.-dia. tape recorder may set pattern for future satellites. It has negligible flutter, low power needs.

Designed and built by Raymond Engineering Laboratory, Inc., of Middletown, Conn., these very-low-power, miniature tape recorders will be used in the *S-15* gamma-ray measurement vehicle (M/R Feb. 6, 1961), *S-16* orbiting solar observatory (OSO), *Tiros II* weather satellite, *S-51* international ionosphere system, and in a series of non-orbiting space probes.

Newest of the recorder series is the model 1515 developed for *S-16* under subcontract with Ball Brothers Research Corp., system manager for the satellite program.

OSO is a 425-lb. satellite which will make spectrophotometric studies of solar ultraviolet and X-ray radiation. (Scheduled for launch by a *Thor-Delta* vehicle during first-quarter 1961, it reportedly has slipped now to second quarter.)

The new unit is a time compression recorder which will be used to store data from experiments performed in *S-16*. The two recorder channels will store data from a number of sensors in a multiplexed FM system.

The program to develop this advanced recorder was begun in June, 1960, and the recorders have been undergoing additional development until recently. Final flight units are now being completed and will be delivered shortly. An earlier model (type 1447) was developed for the *S-15*.

• Flutter reduced significantly— Many design changes have been introduced into the new unit. Flutter characteristics of the Model 1515 recorder are exceptional and can be attributed largely to the use of a double capstan drive system which controls tension and speed of the tape across the heads.

Flutter characteristics of less than 1% peak-to-peak over a bandwidth of 0-300 cps are achieved through use of the double capstan transport drive. Raymond engineers have told M/R that new manufacturing techniques have consistently produced capstan assemblies with runout of better than 10-15 microinches.

Flutter characteristics of the *S-15* recorders are good, although more difficult to achieve since this unit does not have the double capstan design, the company said.

Since all of the recorders manufactured or being developed for satellite applications by this laboratory are for use in multiplex FM systems, elimination of noise and the reduction of flutter to low levels has been the greatest single problem.

Judicious choice of materials and components has reduced the mechanical noises in the machine to extremely low levels, its designers feel.

The use of low-noise, ultra-precision bearings is an example of the effort that has been made in minimizing noise produced by components in the machine. Type K-1-A magnesium, used as the frame material, also assists in damping mechanical noises in the mechanism.

Of the noise produced by the electrical system, amplitude modulation was a severe problem. However, extensive development of electronic circuitry has proven that amplitude modulation of 3 to 4% is practical.

• Weighty mechanical problems— On an overall basis, mechanical problems of the tape recorder have given the most trouble in developing the recorder for satellite applications. The tape transport must be extremely efficient in order to maintain the low power consumption levels required in satellite systems. A highly efficient (40%) motor was developed and is now widely used in all recorder applications.

Sources of friction throughout the tape transport must be kept to extremely low levels. The largest single source of friction in the tape transport is the tape loop itself, which has been reduced to tolerable limits through the use of lubricated tape. Extensive use of electrofilming and electrolizing processes have further helped in reducing the friction on rubbing surfaces.

Space Use

by Charles D. LaFond

Mylar belts are used exclusively in the transmission for the tape recorder machines. They assist in absorbing pulsations transmitted through the machine members. Gearing would be intolerable since it would contribute greatly to flutter problems.

The Mylar belts in use in these recorders are necessarily extremely thin, since variations in thicknesses change the pitch line of the rotating members and produce speed changes which result in flutter in the output signal. It took a considerable development effort to produce the thin Mylar required for fabricating belts of the desired quality, exhibiting the long life needed for these applications.

• **New hybrid drive**—The low power requirement of less than 1 watt (at playback speed) for the machines is attributed largely to a hybrid DC-AC transport drive motor, also developed by Raymond. At start, it operates as a DC motor until synchronous speed is achieved. An inverter supply then drives the motor synchronously.

Extensively developed and highly reliable transistorized circuitry is used throughout to further minimize power consumption. Temperature compensation of electronic assemblies has produced a gain stability of 1 db, Raymond says.

A precision-drive capstan is located on each side of the erase-record-playback head assembly, with the lead capstan 1% larger than the trailing capstan. Both are driven by the motor at constant speed, but the larger capstan provides a differential speed between the two.

The drive system creates a constant tape tension across the heads and isolates this section of tape from disturbing forces external to the capstan assembly.

Record time for most applications is approximately 100 minutes, with playback accomplished in five minutes or less. Characteristics will be determined by satellite orbit time and the length of time the satellite is within range of a receiving station. For different applications, the range of record-to-playback speed ratios can vary from 1:1 to 50:1.

In the *S-16* recorder, maximum total power consumption during the record mode is 0.75 watt. Frequency response during the record mode is from 100 to 1300 cps which reproduces at approximately 1.8 to 24 kc. Record speed is 0.60 in./sec., while playback is accomplished at 11 in./sec.

Signal-to-noise ratio is better than 30 db and amplitude modulation is less than 10% of the carrier signal. Second harmonic distortion is less than 2%, says Raymond.

The recorder stores 300 feet of tape in an endless-loop configuration. Size of the hermetically sealed 4-lb. package is 7 in. dia. x 3 in. in diameter by three inches in height. Two data channels are provided.

Constructional characteristics include shafts mounted in preloaded, precision ball bearings. Preload values are chosen to prevent relative motion of shafts with respect to the frame. This is determined by measured vibration limits developed by booster rockets during launch.

The recorder designers stressed that materials used in the units have been selected for maximum efficiency consistent with minimum weight. Wherever possible, use has been made of standard commercial components exhibiting the high performance characteristics required by the delicate role of the recorder.

• **Future needs**—Raymond feels that the greatest single problem for future tape recorder development appears to be in the recording tape.

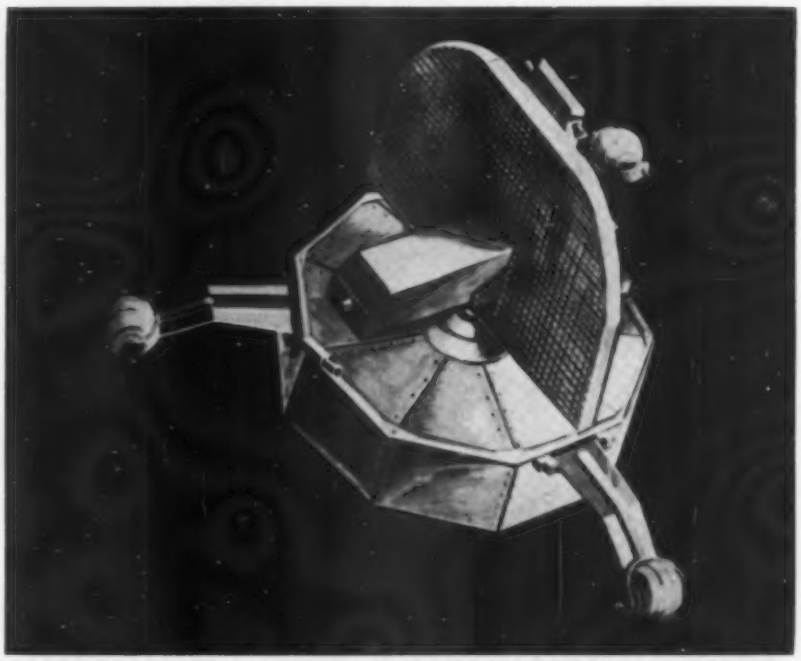
Friction reduction in the tape loop will reduce power requirements for future applications and increase tape life, yielding a longer useful satellite life. Extension of the temperature environments for magnetic recording tape is also a prerequisite for successful future applications.

Fabrication and design techniques developed by Raymond in *S-15* and *S-16* satellite programs have laid the groundwork for future satellites. Many of these techniques are now reduced to the routine rather than the extraordinary, and much of this work can be utilized in coming programs.

For the foreseeable future, the company intends to press its tape recorder activity in the low-power, subminiature designs for satellite applications.

Some preliminary work has been started on a similar transport designed for digital application. Some additional work is anticipated in further developing the transports to accept an even wider range of environmental conditions and maintain or improve the reliability and life of existing designs.

At the present time, Raymond is developing and manufacturing tape recorders, under a NASA subcontract, for a rocket probe in which it will be used as a delay device alternately recording and playing back signals from an RF impedance probe. ¤



SATELLITE RECORDER installed in base section of NASA's S-16, Orbiting Solar Observatory, will store experimental data and play back on orders from ground.

The most proven large ballistic missiles, the Atlas (left) and Redstone (right), will launch America's Astronauts. Main-stage engines of both are by Rocketdyne.

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AGAVE Tracking System Goes To Sea

Cubic equipment is easily adapted to eight ships for use on both ocean ranges—and in Project Mercury

SAN DIEGO—Cubic Corp.'s AGAVE tracking system is now being installed aboard eight instrumentation ships for use on the Atlantic and Pacific Missile Ranges and in Project *Mercury*.

Only slight modification has been required for shipboard use of AGAVE, which is a self-steering telemetry antenna system capable of acquiring targets in a large angular region and tracking them for maximum receiving sensitivity or range.

The self-tracking feature of AGAVE (Automatic Gimballed-Antenna Vectoring Equipment) makes it especially adaptable for shipboard, because no stable platform is necessary. The system can acquire and track even when a ship is pitching or rolling.

The wide-beam AGAVE system can work against any telemetry or other signal source in a missile or satellite, using a roughly angular cone ± 20° around the antenna boresight line. Cubic reports that AGAVE has tracked a 250 mw. source at ranges greater than 5000 mi.

The system already has been used at sea in tracking *Discoverer* shots, military missiles fired from Cape Canaveral and *Scout* missiles fired from Wallops Island.

• **Quadruples capability**—In the shipboard installations, narrow-beam antennas are slaved to the system and locked onto target after its acquisition by the broad-beam antenna, a 12-ft. antenna with a 20° beam width and a gain of 18 db. or better.

AGAVE is going aboard AMR's American Mariner, PMR's Joe E. Mann, Knox Victory, Nyantic Victory, Range Tracker and Skidmore Victory and aboard two *Mercury* instrumentation ships, Rose Knot and Coastal Sentry. Anti-corrosion coating for the sea-going AGAVES is provided by Magna Coatings and Chemical Corp., Los Angeles.

First installation was on the American Mariner (see photo). Shipboard operation normally is on the 215 mc. to 260 mc. band although the system can handle any standard IRIG telemetry band. If angular tracking is required, the ship's gyrocompasses can be employed for input to a computer to provide this information.

According to Cubic, AGAVE's wide-band tracking receiver can acquire and track telemetry signals at ranges up to four times as great as usable telemetry ranges.

"Even with the broad-beam pattern, overall tracking sensitivity can still be maintained in the acquisition tracking units, since its receiver can utilize narrow-band technique for significant improvements in sensitivity," says Cubic engineer Harold D. Dickstein. "Such narrow banding is possible because tracking information does not depend on reception of the entire wide-band telemetry signal."

• **Free from jitters**—Since narrow-beam systems are being directed, good wide-beam tracking accuracies are required. These accuracies are obtained by use of interferometer techniques.

This approach, according to Dickstein, produces a sum channel output free of the jitter normally encountered in sequential lobing systems. The signal presented, in addition to furnishing tracking information, provides usable telemetry data. Although the tracking unit does not have the gain of the slaved narrow-beam unit, it is said to offer a significant improvement in data reception due to its ability to keep a relatively high gain system on the target.

If acquisition is not a problem and tracking alone is desired, the interferometer tracking receiver can be applied directly to the narrow-beam antenna unit to provide a maximum gain self-directing telemetry data receiving system.

• **Strong points**—Dickstein lists these design advantages of the AGAVE system:

–Precise orientation input is not required since the system acquires on wide beam, wide angle.

–Greater range is achieved than with a narrow beam system, making it useful for tracking out to the ranges expected in future space work.

–Where a rapid slew rate is required for a target passing directly over the antenna, the system can track over the top with wide beam and then return to narrow beam, thus making it possible to use less expensive pedestals.

–A stable platform is unnecessary unless actual angle readout is required.

–It can handle any standard telemetry signal. With modification, it will handle the new telemetry bands of 1435 mc. to 1530 mc. and 2200 mc. to 2300 mc.

–Coast computers make it possible to track through deep fades and plasma sheath blackout during re-entry.

• **In operation**—The AGAVE equipment consists of the gimballed antenna system, a receiver, a servo amplifier, and a gimbal drive which points the antenna system at the target.

It combines an angle sensitive rf interferometer system with a signal-sensitive coherent detector loop. Units for Project *Mercury* will work against signals in the 225 mc. to 300 mc. band

with a frequency deviation ratio restricted to 1, and an expected drift of ± 40 kc. System sensitivity in this case is greater than –140 dbm. for initial acquisition. After acquisition, the system automatically "narrow bands" and sensitivity is improved to –160 dbm. to permit tracking at extremely long ranges even in severe signal fades.

Once the signal is acquired, the system slews itself to boresight and tracks or steers itself automatically to maintain maximum sensitivity.

The interferometer technique used involves phase comparison at the rf frequency with hybrid rings. The resultant output or error data does not depend upon phase stability to preserve boresight information. According to a report made by Dickstein to the National Telemetering Conference, the technique relaxes circuitry phase tolerances normally required for accurate boresight data in interferometer systems. The over-all servo loop gain which is affected by phase errors is, he says, sufficiently insensitive to errors to tolerate phase variations up to ± 35°.

AGAVE uses four helical antenna elements mounted as azimuth and elevation interferometer sensors. A phase difference between each pair of elements is encountered whenever the signal source is away from boresight. The two signals are compared in a hybrid ring which produces two outputs—a vector sum and a vector difference. Subsequent coherent detection and measurement of the sum and difference outputs yields the required sensitivity and tracking accuracy.

Servos drive the four-element antenna assembly in azimuth and elevation to eliminate the phase difference in each pair of elements. After lock-on, the assembly tracks the source by maintaining both phase nulls.

Dickstein says the use of hybrid rings—stable, broadband, non-tunable units—prevents introduction of a boresight error from any phase delay variation in subsequent circuitry.

• **For sensitivity**—Use of coherent detection and narrow-band techniques to maximize system sensitivity is explained by Dickstein this way:

The only data of importance to the tracking system is the amplitude and sense of the error signals in the difference channels. These signals are passed through narrow-band filters to prevent low-level noise saturation in the error detectors. The first if. is 35 mc. to provide good image rejection in the 225 mc. telemetry band. The second if. is 2.2 mc. It is frequency-stabilized by using a voltage-controlled oscillator, (controlled in the sum channel), for local oscillator injection to the 2nd mixer. Since the incoming signal usually drifts over a large range, this second local oscillator compensation is needed so that the second if. is stable within the crystal filter passband.

The voltage controlled oscillator system utilizes coherent detection techniques to (1) "acquire" the incoming signal, even if signal-to-noise ratio is very low, (2) "push" the error channel outputs to the crystal filter passband, (3) pass at least one pair of sidebands and convert this energy to carrier frequency and (4) with the error signal outputs thus obtained, drive the pedestal to acquire the target in space.

After acquisition, there is no need for further searching and the system can be "narrow banded" to a degree compatible with overall receiver and servo loop bandwidth. This narrow banding is accomplished by relay operation, controlled by the AGC feedback output which will energize the relay only when carrier lock takes place.

Further details of the system can be found in a paper delivered to the 1960 National Telemetering Conference by Dickstein and John T. Underhill.

• **Mercury assignment**—Cubic already has delivered AGAVE systems to Bendix Radio Division of the Bendix Corp. for installation at sites around the world in the Project *Mercury* program. They will be used to provide primary acquisition of the capsule as it appears above the radio horizon. After acquiring the capsule, AGAVE through its servo outputs will direct AN/FPS-16 units, which are too narrow for initial acquisition, to the same point.

AGAVE then will provide in itself a self-tracking data receiver system and also serve as the master tracking unit for other receiving antenna systems slaved to it. The *Mercury* units use a quad-helical array built by Canoga Division of Underwood. ⁂

CUBIC'S AGAVE was first installed on ship in the Atlantic Missile Range's instrumentation vessel, American Mariner. Quad-helical antenna unit is in center.

New GE Flight Control System Being Evaluated

A NEW, SELF-ADAPTIVE flight control system is undergoing evaluation tests on North American Aviation's *X-15* simulator.

Called GESAC, it differs from conventional flight control systems in that a frequency sensor is used to measure continually the aircraft response and system gain is adjusted automatically to attain the desired response level.

Developed by General Electric's Light Military Electronics Department during the last two years, the system is being tested under a joint effort by the Air Force, North American and G.E.

The evaluation program has reportedly shown GESAC's ability to accomplish its control task over a wide range of flight conditions.

The self-adaptive method of attaining invariant response, says G.E., also eliminates the need for external information such as air data for gain changing. Additional benefits gained, the company says, are reduction in system design and in flight test time.

The GESAC system successfully passed a recent flight test program when installed in a Convair F-106 Delta Dart at G.E.'s flight test facility in Schenectady, N.Y., under a Navy contract.

An exclusive M/R interview . . .

Lee Has Big Propulsion Pla

Douglas subsidiary aims at major role in liquid space energy work; colloids will get early emphasis

LONG BEACH, CALIF.—Astropower, Inc., the new propulsion subsidiary of the Douglas Aircraft Co., already has several proposals in the hands of the Defense Department and the National Aeronautics and Space Administration.

No details are available, but it is known that the firm plans to avoid solid-propellant rocketry and work only in the specialized liquid propellants of the chemical rocket field.

Among the early hardware contracts Astropower expects to bid on will be components on the *Rover* nuclear rocket. Such items as pumps, nozzles, actuators, control systems, feed systems and similar hardware are in Astropower's field of interest on *Rover*.

Astropower was formed last Nov. 7. Company president Y. C. Lee (photos) has made it clear the firm hopes to become a major factor in primary propulsion and auxiliary power for space vehicles. He is laying out a careful program to skim the cream of contracts in this space energy field.

Astropower intends to specialize in various electrical propulsion systems, nuclear propulsion, solid state devices and systems for nuclear auxiliary power (SNAP), as well as related fields in the space sciences. (M/R, Jan. 2, p. 39)

Lee told M/R that in reactor technology, Astropower plans to conduct research and development in gaseous core types, but has no present inclination to get into the solid core reactor programs such as the *Rover* and *Pluto* projects. Any reactor work done by the company will be aimed at propulsion and auxiliary power fields, according to Lee.

• **Emphasis on colloids**—In electrical propulsion, the colloid, ion and arc-jet types will be studied, with initial emphasis on the colloid system. Colloid, or heavy particle, acceleration is preferrable for manned, long-distance space flight, Lee feels, because of shorter time-to-destination. High thrust/weight ratio engines will be worked on with a view toward providing higher acceleration levels than ion systems offer.

In a long voyage utilizing low-acceleration ion engines, Lee said, the additional equipment required to support the crew for the longer period outweighs the extra equipment required by a colloid system that would get the mission accomplished in shorter time.

He emphasized that the argument holds true mostly for manned missions, and indicated that ion systems would also be studied by Astropower. Specific areas of investigation include source problems, high current density through use of a cavity source, and a better source in terms of yield and ease of working with water.

Y. C. Lee, boss of Astropower, hi[s] big co

The colloids, however, appear to take first priority in the electrical field, with present accelerations of 10^{-3}g now obtained in lab work. The ultimate level of the engine's efficiency is governed by power technology. In this light, Lee noted, power losses with the heavy particle system are less than with the ion system, and in addition, ion systems work at a higher temperature —about 1500°F. The colloid engine, working at ambient temperatures, has an advantage in this respect, he said.

• **Neutralization**—Another area of advantage for the colloid system is the neutralization problem now plaguing

Plans for Astropower

ion engine makers. The "nagging backache" of the ion rocket, neutralization is expected to trouble the heavy particle system to a much less extent than ion types. Sputtering troubles are about the same for both systems and the key to this appears to be in the beam focusing, Lee said.

In the economic aspects of the electrical propulsion field, colloidal propellants are much less expensive than ionizing propellants such as cesium, which is selling at $900 per pound.

Summing up the advantages and disadvantages of the two systems, Lee concluded with the belief that an electrical propulsion system using the heavy particle approach could be brought to the same state of development as the ion engine, while costing less and taking less time.

big contracts from DOD, NASA.

"For the same amount of money as the government has now spent on development of ion engines," he stated, "we could have had a colloid system much further along."

He expressed little hope, however, that any such sudden funds would appear.

• **Other efforts**—In its research and development work on arc jets, Astropower will probe the recombination of hydrogen in nozzles as the primary problem. As a critical performance problem, the recombination difficulty will come in for a large share of attention.

Chemical propulsion efforts will be limited to those special liquid fuels and oxidizers which, when combined with a third component, will yield very high impulse while retaining handleability.

A three-component system designated "Hyfox" will be Astropower's so-called tribrid combination, consisting of liquid hydrogen, liquid oxygen and a third component to increase performance. Such an additive might be any metal: magnesium, lithium, aluminum or other material in a jelly or slurry form. The slurry can be contained in a separate tank or introduced into the hydrogen tank.

Such storable propellants as pentaboranes will also get some attention, as will various boron compounds.

In the field of internal power for space vehicles, Lee expressed considerable interest in fuel cells, nuclear power packages, solar sources and solid-state devices—notably thermoelectric types. Work on thermoelectric material formulations will be carried out, with expectations of achieving 15% efficiency in operation.

Other power equipment and power source systems will be studied with the same eye to specialization.

Further along the road of product development and corporate planning, Lee hopes, Astropower eventually will turn out some consumer products, especially in power applications, as a result of work in space research.

"We have all the necessary financing arrangements made with Douglas to keep us going for quite a while," Lee said, "and we could keep about 450 people busy for several years even if we received no contracts at all. But if I thought we would go along for any length of time without getting contracts, I wouldn't be with the company."

Temporarily headquartered at Douglas Aircraft Co.'s Long Beach facility, Astropower expects a master plan for its new permanent home to be completed about mid-March by Wm. L. Pereira & Associates. The new site will incorporate all administrative, engineering, research and test facilities. No official announcement has been made as to location, but the site will most likely be in the area of Newport Beach, Calif., south of Los Angeles. ⌗

Three Firms in Running For Saturn Tanks Award

WERNHER VON BRAUN will choose between Boeing, Chance Vought and Martin for a $2¼ million contract to supply 42 propellant tanks for *Saturn* boosters 6 through 10.

Von Braun's Marshall Space Flight Center, National Aeronautics and Space Administration, will manufacture the tanks for the first five *Saturns* in-house and will continue to assemble the boosters for *Saturns* 6 through 10. After that, the entire booster stage will be constructed by an industrial contractor.

Delivery of the 70-in. tanks will begin in mid-1962. Boeing, Chance Vought and Martin were chosen from 18 bidding on the contract. Von Braun will choose the winner after NASA negotiates terms with all three.

NASA Engineer Patents Winged Rocket Vehicle

AN ENGINEER on Wernher von Braun's staff has obtained a patent on a vehicle called the "Rocopter," which combines a rocket booster and a compartment with rotary wings for re-entry.

Friedrich G. von Saurma, of the *Saturn* Systems Office at the Huntsville, Ala., center of the National Aeronautics and Space Administration, invented the vehicle, which has wind-rotatable blades that gradually open as it travels along a ballistic trajectory in space, after separation from the booster. The airfoils' pitch could be changed to vary the rate of deceleration.

The Rocopter's gliding angle and azimuth would be regulated by ground radio control or, if men were aboard, by manual steering. Von Saurma suggested that the vehicle might be used by the armed services for rapid reinforcement and supply of isolated troops or scientific units. A civilian application, he added, might be very fast transport of mail, freight or passengers over long distances.

Von Saurma, who was technical director of the test and training center for *V-1* missiles at Peenemunde from 1943 until the end of World War II, came to the United States in 1953 and has been a citizen since 1959.

Recording Liquid Test Data

CANOGA PARK, CALIF.—A new computer reporting system at Rocketdyne division, North American Aviation, makes it possible to record automatic processing of data generated by liquid-propellant rocket engine tests in a unified system on a digital computer.

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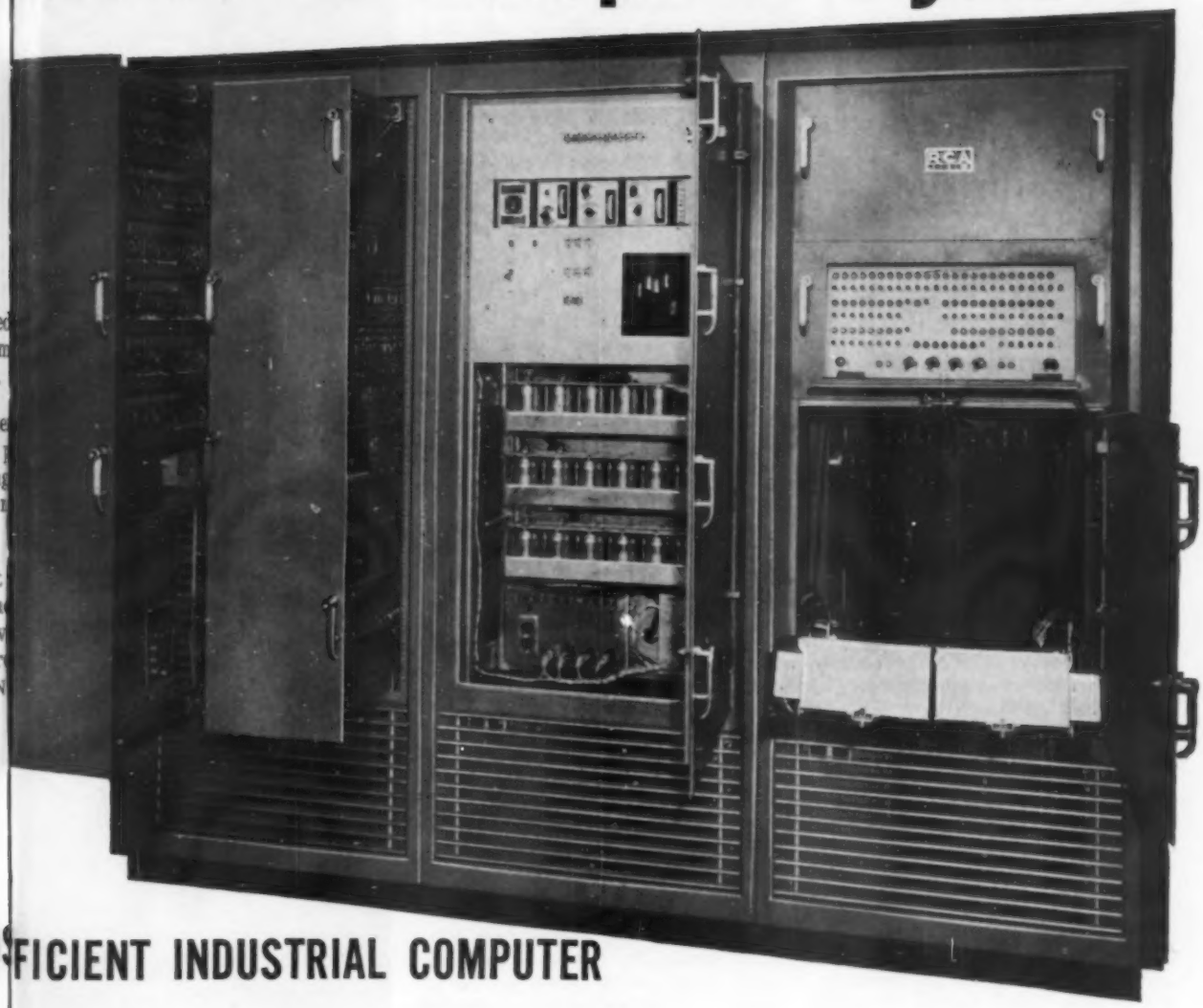
industrial Computer System



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Toward Safety in Handling of Propellants

by H. A. Volz
Safety Director
Callery Chemical Co.

THE RAPID DEVELOPMENT of propellant technology is generating a unique challenge: establishing safety standards for the handling of these high-energy materials.

Notable progress is being made even though the art and science is relatively new and the materials' properties are not usually completely known.

The formula used in propellant handling programs at Callery is basic to all safety procedures. If everything possible is known about the components in a given hazardous situation, conditions can be formulated to prevent injury to the involved personnel. In a sense, a safety program is a proving ground for both the hazard and the required protection that must be considered for large-scale production.

The major points in propellant fuel handling are toxicity and fire and/or explosion dangers.

The toxic nature of a propellant will vary with the particular substance. Taking pentaborane as an example, the three main phases in a toxicity program are detection, protection and treatment. Studies have shown that an instrument could be developed for detection of pentaborane vapors in the range of 200 parts per billion, a safe concentration; Kel-F or teflon clothing is necessary to protect the wearer because it will withstand pentaborane exposure without serious deterioration; respiratory equipment must be of the self-generating or air-supplied type.

There are no antidotes for overexposure cases. Each case would be treated symptomatically using muscle relaxants and anti-convulsive agents as indicated from the developing indications.

Blood chemistry tests based on protein bound boron will indicate definitely if an exposure has occurred; they are used routinely on all personnel who show clinical symptoms which may be related to overexposure.

• **Blast problems**—In the appraisal of fire and explosion hazards, the questions that must be answered are more numerous and complex. Typical are the following: (1) Is the material spontaneously flammable? (2) Does it make other materials pyrophoric? (3) Can you control or extinguish fires involving this material? (4) Will it detonate by impact? (5)Will it react with other materials in its environment to produce detonation?

Tests always begin with micro-quantities of the material under study. A great deal may be known about the substance—or nothing at all. To find out how sensitive it is to impact, a tiny amount is placed in a standard container and subjected to a drop-weight test. To find out how easily a liquid propellant is detonated, a small amount is exploded with a standard charge. To measure the effect of heat on a given material, micro-samples are run through a thermal stability tester.

Finally, to measure the explosive force of a propellant, one method used is the dent-plate test, which gives a direct reading in millimeters of the depth of dent caused by the explosion. Most of the micro-testing is carried out in a laboratory specially designed for this purpose. A maximum of five persons are permitted in this building at one time, and all personnel wear the safety clothing, head and eye protection, and respiratory apparatus required for the material in use and operations taking place.

• **Range safety**—For larger scale testing, a series of bunkers have been erected on a "firing range" in open areas. In one typical setup, it is made impossible to complete firing unless shunts are first removed from two widely separated points, thus energizing the circuit through a 30-second delay alarm system. For testing of fuel properties under actual firing conditions, controls are housed outside of the test area behind a two-foot thick reinforced concrete wall. Blast force to the other side of test area is cushioned by heavy steel cable curtains.

The hazards of propellant fuel handling and production are being lessened with each new advance in safety know-how. We can provide the physical protection to guard against human error, but our best chance for success in safety lies in the complete acknowledgement and understanding of all the hazards that face us. ⌗

PROPELLANT material explodes in detonation tests. Remote controls are located outside the steel-walled cell.

DENT PLATE tester measures explosive strength of samples. Probes are safety shunts to avert accidental detonation.

At ARS solids conference . . .

Consumable Case Rocket Described

by Frank G. McGuire

SALT LAKE CITY—A consumable-case solid rocket promising to add 700 nautical miles to ICBM ranges was among developments disclosed at the American Rocket Society Solid Propellent Conference here.

A discussion of plug cluster nozzles designed to reduce or eliminate some present difficulties with other types also drew high interest.

Launch of the *Minuteman* ICBM at Cape Canaveral within two minutes of the conference opening here provided as dramatic and resounding a gavel as any chairman could have asked—particularly since the meeting drew 650 engineers and scientists to the backyard of two companies producing rocket motors for *Minuteman.*

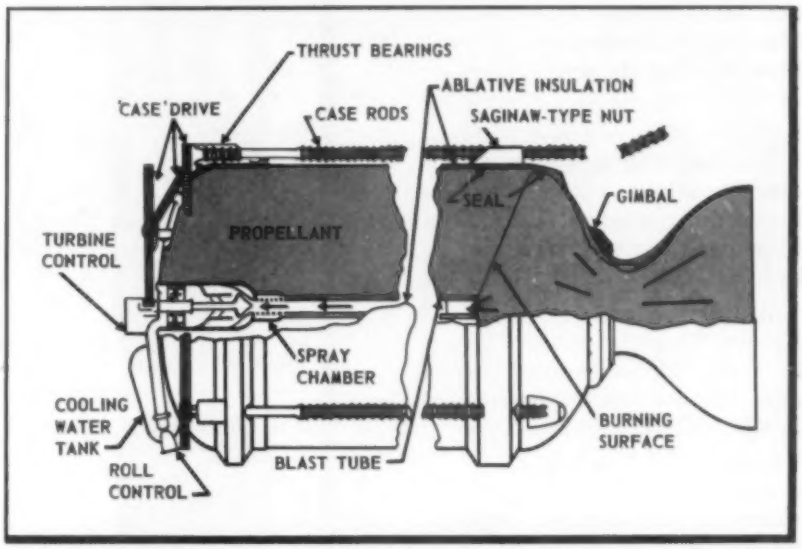
Two Soviet Embassy officials turned up at the meeting. (See box and editorial.) Their presence was taken by some as an indication the USSR lags in solid rocket technology. Two liquid propellant meetings held in the past two years were ignored by the Soviets. But they went to considerable trouble to attend the solid rocket conference here and the one last year in Princeton, N.J.

During this conference, the Soviet officials made a careful selection of technical papers and attended the technical sessions, with the exception of the classified session on *Minuteman.*

The consumable-case solid-propellent rocket motor discussed by A. N. Baxter of Space Technology Laboratories was said to have numerous advantages. Included in these would be a 40% greater burnout velocity, a nominal burnout mass ratio of 30, an increase of 700 miles in ICBM ranges, a continuously jettisonable case, case weight one half of conventional weight, a solid film cooled nozzle, inherent roll control capability, and an insignificant tail-off time and impulse.

In application, Baxter recommends use of the unit as first stage for medium-sized ICBMs, or as second stage for much larger vehicles.

Studies of the consumable case rocket (CCR) were carried out using a 200,000-lb.-thrust rocket with a weight of 50,000 lbs. and chamber pressure of 700 psi as a basis for calculation.



CUTAWAY DRAWING of the consumable case rocket (CCR) discussed by STL's A. N. Baxter at ARS meeting. Spur gear drive shown was called inferior to two other types.

At a quick glance, the CCR looks like this: a solid cylinder of propellant burning at its aft end, a fore-end dome, a converging-diverging nozzle, connecting rods to maintain appropriate spacing between fore-end and nozzle, and a drive mechanism to advance the nozzle as the burning surface moves forward.

The propellant charge is surrounded by ablative material and radial stress is resisted by hoop tension in the nozzle only, while axial stress is resisted by the connecting rods. A blast tube is located axially through the center of the grain, and exhaust gases are carried through this tube to drive a turbine which powers the nozzle-advance rods.

The ablative material surrounding the propellant charge is gradually carried along the inside of the nozzle by the advancing drive mechanism, thus providing solid film cooling of the throat.

Three types of drives are considered for operation of the nozzle-advance rods: Spur gear; bevel, hypoid or spiroid gears; and a worm gear. Various design characteristics of each type of drive were discussed in the paper. Least desirable of the three types, according to Baxter, is the spur gear.

Performance calculations used in the study were conservative, and the STL author suggested further advantages possibly to be gained from a fabrication, cost and logistical standpoint. These include potential characteristics thought out of reach of solid rocketry to a great extent.

A restart capability could be included in the design by locating an inert section of propellant across the end-burning grain. When this section is reached by the combustion surface, thrust is terminated. A timing device working with a restart system could re-ignite the propellant after the suitable coast phase is over.

Auxiliary power capability is inherent in the turbine mechanism used to advance the nozzle assembly, and would be in addition to use of the same exhaust gases for roll control.

Tail-off impulse would be insignificant, according to Baxter, and thrust termination would be easy and instant. Severing the connecting rods which take up the axial stress at a precise instant would cause the nozzle assembly to be blown away from the rocket, and the sudden pressure drop would effect immediate combustion cessation.

Recoverability of the hardware was also discussed, as was nearly 100 percent loading density, "case" repairability, nonpropulsive and nonexplosive characteristics in event of fire, thrust level adjustment without low efficiency

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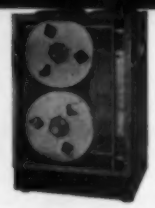
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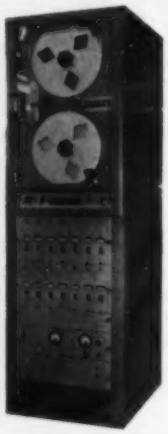
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performance, and the other advantages.

• **Plug cluster nozzles**—In a design intended to reduce or eliminate both the inefficiencies suffered by conventional rockets during altitude changes and the problems associated with annular plug-nozzle engines, three authors from Pratt & Whitney described a cluster of rocket engines grouped about a truncated plug.

The arrangement utilizes relatively small rocket engines grouped about, and tilted toward the axis of, a truncated plug of variable length. With certain design characteristics incorporated, the cluster produces more thrust than the sum of the individual rocket chambers.

SALT LAKE CITY—Efforts by two Soviet Embassy officials to take a look at several major facilities of the Minuteman program were blocked here during the American Rocket Society's conference on solid propellants.

Gen. Mikhail N. Kostiuk and Arkady Y. Golosky attended the meeting after pre-registering by mail. They signed up for all field trips to be conducted, including trips to the Minuteman assembly plant and train facility at Hill AFB; Hercules Powder Co., makers of the Minuteman third stage; Thiokol Chemical Corp., manufacturers of the Minuteman first stage; Marquardt Corp., producers of ramjets for Bomarc; and Sperry Utah Engineering Laboratories, prime manufacturing contractors on Sergeant.

Permission for the visits was flatly denied.

The general and his aide were refunded $4.75 each by the American Rocket Society.

A. Chamay, J. J. Horgan and D. Migdal reported test results showing the plug cluster nozzle to be similar in many respects to the plug nozzle, and both being superior to the conventional bell chamber engine. During tests, the plug cluster nozzle used UDMH and nitrogen tetroxide propellants at a chamber pressure of 300 psia. The authors also pointed out applications to solid propellants.

Most attractive using between 12 and 50 individual nozzles, the plug cluster operates over a wide range of pressure ratios without inheriting the serious mechanical problems of its cousin, the annular plug nozzle. Studying the design, P&W engineers evaluated efficiency thrust vector control, reliability, hardware needs, and other parameters—concluding that the concept has considerable promise.

Problems still to be faced in the concept include propellant physical and ballistic properties, aerodynamic roughness, turbine speed control, and similar hardware difficulties.

←—Circle No. 11 on Subscriber Service Card.

Although the plug nozzle annular engine made its debut some time ago amid great fanfare, its use has been somewhat restricted to experimental testing because of mechanical problems associated with the design. Since the plug cluster nozzle design uses conventional rocket engines already developed—merely grouping them about a plug—there is little unknown about the engines themselves.

At first, the use of a number of engines seems to pose a reliability problem, but the authors state that the design incorporates a "built-in spare engine." The utilization of already-developed relatively small engines rather than embarkation on a new development program was advocated, in the interests of reliability.

Hardware used in testing the design consisted of two units, one with 12 individual nozzles, and another with 24 nozzles. Tests were conducted over a wide range of pressure ratios, simulating atmospheric conditions from liftoff to exit from the atmosphere.

Simultaneously, an all-external expansion plug nozzle designed with the same area ratio and an annular throat was tested as a control device.

A number of plug lengths were tried, simply by truncating the plug and using the same contour. Little difference in performance was noted, even after extreme shortening of the plug.

• **Other papers**—In addition to the papers on consumable-case rockets and plug cluster nozzles, the ARS meeting heard about an unconventional grain configuration proposed by William C. Stone, of Rohm & Haas Co., to compensate for erosive pressure peaks during combustion.

Stone proposed a slotted tube grain design intended to reduce the initial burning surface, using a progressivity ratio greater than unity. Using the slotted grain design, he said, progressivity ratio adjustments are possible by simple adjustment of the slot length.

Writing on metal additives to solid propellants, A. W. Blackman and D. K. Kuehl of United Aircraft Corp. cite advantages to be gained through use of binary light metal mixtures and alloys, rather than pure metals.

What the authors describe as "appreciable increases in theoretical performance" is signified by an example of adding the bimetal lithium-beryllium to a propellant of 15% hydrocarbon binder, 70% ammonium perchlorate, and 15% metal additive. The result is 12 seconds increased specific impulse over what would result from a pure beryllium additive. In addition to the impulse increase, combustion instability is reduced.

Also covered in the research were lithium, aluminum, and other metals. ⌗

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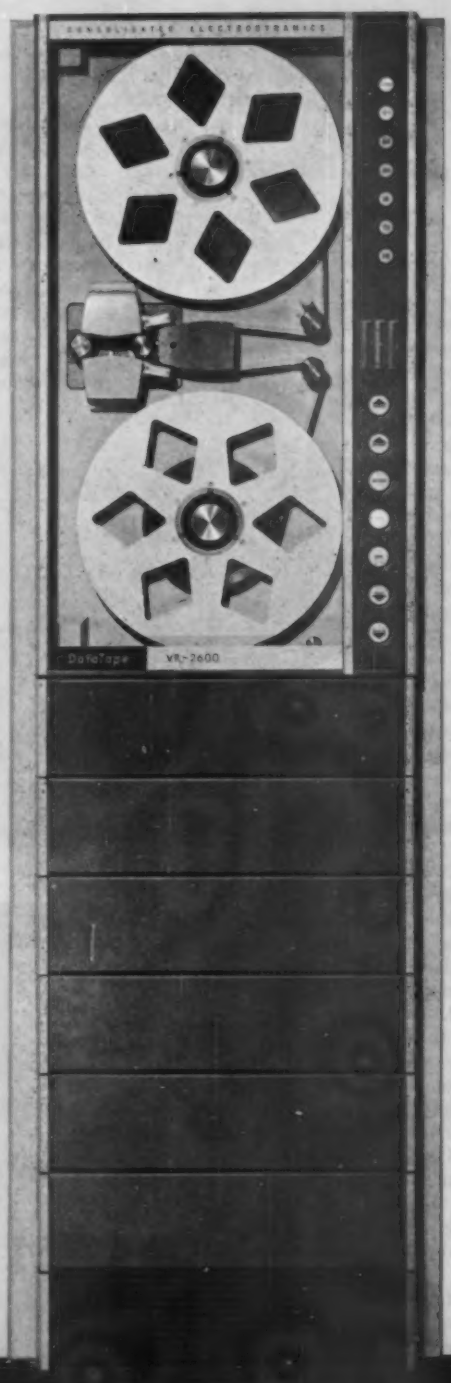

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Gaseous Laser Holds Vast Promise

Bell Labs development will exploit data-handling capacity of coherent light—broad applications seen

BELL TELEPHONE Laboratories has developed a continuous-output coherent optical maser or laser. The new device promises magnitude increases in future data-handling capacity for communications.

Employing a gaseous medium, the approach is considered vastly more sophisticated than more conventional systems which use solid-state masers for optical pumping. Output from such systems is coherent, but pulsating.

The output from Bell Labs' laser (light amplification by stimulated emission of radiation) is in the infrared portion of the frequency spectrum. Its coherent radiation beam is highly directional, having a spread less than one minute of arc. A gaseous laser on earth, operating through a suitable telescope, could send a beam to the moon that would cover a spot smaller than one mile in diameter, the scientists say.

• **BTL's method**—A helium and neon gas tube is used, and an electrical discharge flows through it. Helium atoms are super-excited to an unusually high energy level. Neon atoms in the mixture absorb some of this energy during a resulting collision process; these can then be stimulated to radiate the added energy on demand.

Contained in a tube, the beam is reflected alternately and with increasing intensity throughout the length by semireflecting end plates. Some of this beam is transmitted through the end plates forming a very narrow beam output of coherent infrared light.

The narrow spectral line width of the output beam is 0.00001 as wide as that from other coherent light sources. BTL reports that this property has, for the first time, made it possible to observe difference-signals at radio frequencies between two optical lines.

• **A low-power device**—Output power is roughly 0.01 watt; input for the electrical discharge is in the "tens-of-watts" range, Bell says.

At this level of operation, the tube is so cool that it can be held in the hand without discomfort. The level of operation can be increased by using larger-diameter tubes.

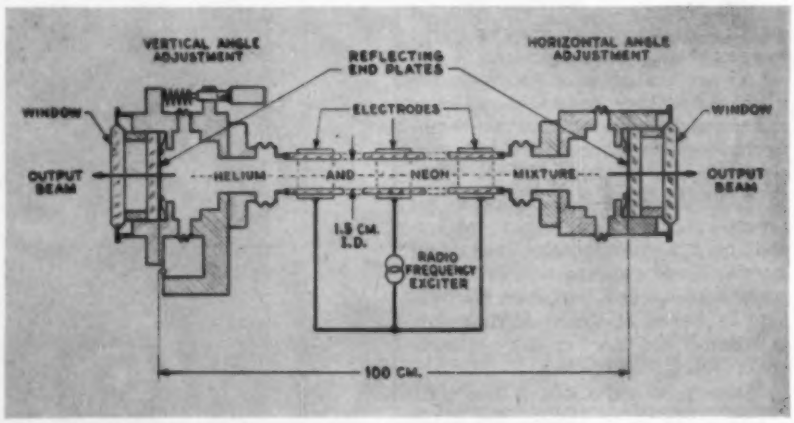
Gaseous lasers and solid-state lasers are expected to complement each other in their applications. The latter is essentially a high-power device, and Bell feels that it will have important uses even if limited to pulsed operation.

Since the neon atoms can radiate energy from almost any one of four upper energy levels to one of 10 intermediate levels, up to 30 discrete frequencies can be emitted by the laser, depending on the specific mode of operation.

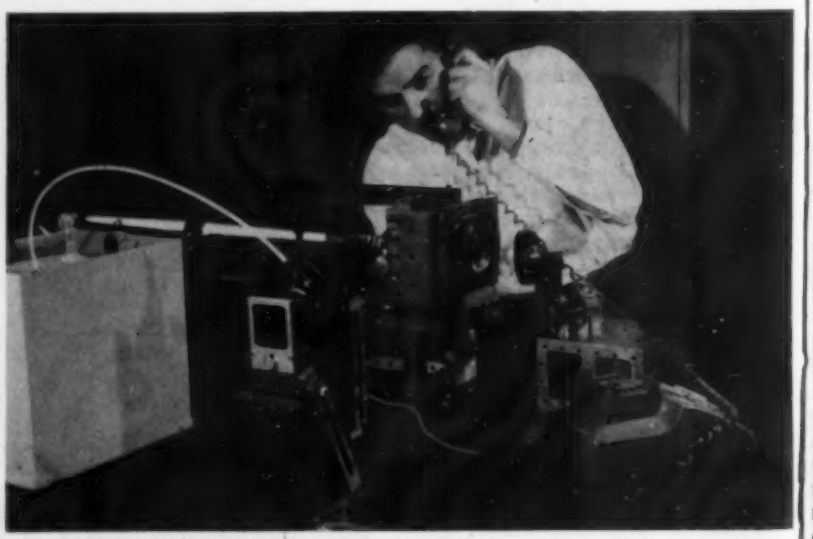
• **Broad frequency range**—The range of possible wavelengths lies between 9000 and 17,000 Angstroms. Present laboratory models, according to BTL, have operated at five different wavelengths between 11,000 and 12,000 A.

The output line width is far sharper than that of ruby lasers. Light emitted by ruby devices is about 60 times narrower than the ruby's normal fluorescence.

Normal fluoresence from the helium-neon mixture is already that narrow, and laser action narrows the beam more than 100,000 times more. Thus



GASEOUS LASER technique for impressing telephone talks on coherent IR beam.



CUTAWAY VIEW of Bell Labs' gaseous laser. From an input of tens of watts for the electrical discharge, a 0.01-watt output can be obtained.

the line is thousands of times sharper than the best spectroscopic lines available in the optical region, Bell scientists assert.

It is expected that different output frequencies may be produced using other gas mixtures with comparable success to that of the helium-neon mixture.

• **Applications equally broad**—The gaseous laser should provide physicists with an immensely useful tool. For example, the narrowness of the line will afford an accuracy hitherto unattainable in spectroscopic work at these frequencies.

Another possible application of the device is the measurement of distances of many miles with extreme accuracy. Continuous laser action, moreover, is forcing renewed interest in the whole field of gaseous-discharge physics.

Communication engineers have had an urgent need for a continuously operating generator of coherent optical frequencies. The wide bandwidths associated with carrier frequencies in the IR portion of the spectrum could provide a vehicle for heavy data-handling capacity.

BTL scientists indicated they have been experimenting with several methods of modulating a signal on an optical carrier. As an initial experiment, in December last year they impressed a telephone conversation on a laser signal by using a Kerr Cell.

Broadband modulation has been accomplished at frequencies up to 60 kc, they said, and other modulation schemes may result in systems operating as high as several thousand megacycles. ⌗

Autonetics' Minuteman Test Area Highly Stable

DOWNEY, CALIF.—Accurate testing of *Minuteman* missile guidance systems demands sensitivity of a degree never before required of inertial navigation equipment.

Engineers at Autonetics division, North American Aviation, have designed two devices which cancel out effects of earth trembling and provide the most stable area possible for testing *Minuteman* equipment.

One device is a level detector which is actually a super-sensitive, electronic seismograph. The detector weighs about 20 lbs. and is the size of a portable typewriter. Its core is half an inch thick and about as round as a quarter. It works on two axes compared with a seismograph's one and is capable of measuring earth movement to millionths of an inch, according to Autonetics.

The detector is placed on a 7000-lb. horizontal slab of granite. ⌗

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TYPICAL ELECTRICAL DATA	Output (volts/1000 rpm)	7 (typical) .5-30 available	2
	Rated Speed (rpm)	3600	5000
	Linearity (% to 3600 rpm)	.07	.1
	Winding Resistance (ohms)	125	
	Output Impedance (ohms)	—	36
	Ripple Voltage	2% above 100 rpm	2.5% at 3600 rpm
TYPICAL MECHANICAL DATA	Friction Torque (in. oz.)	0.25	0.25
	Rotor Moment of Inertia (gm-cm²)	7	8
	Weight (oz.)	5.5	5

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

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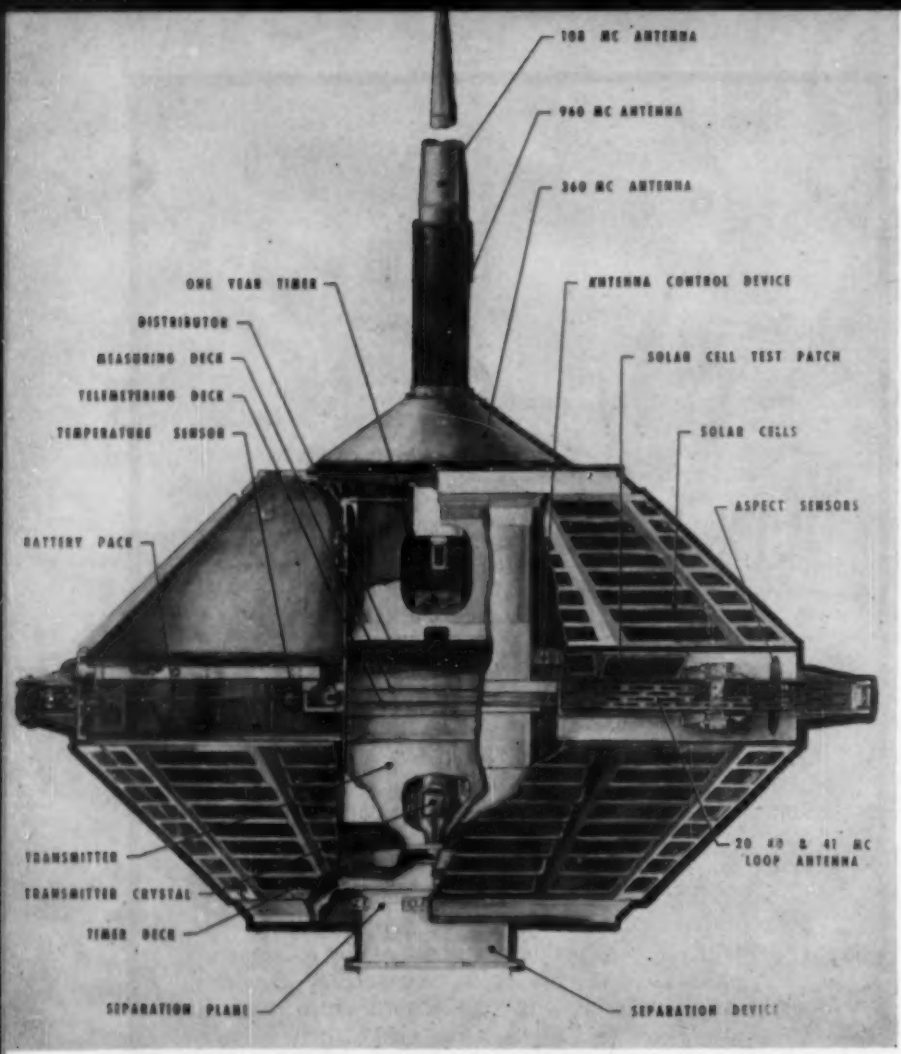
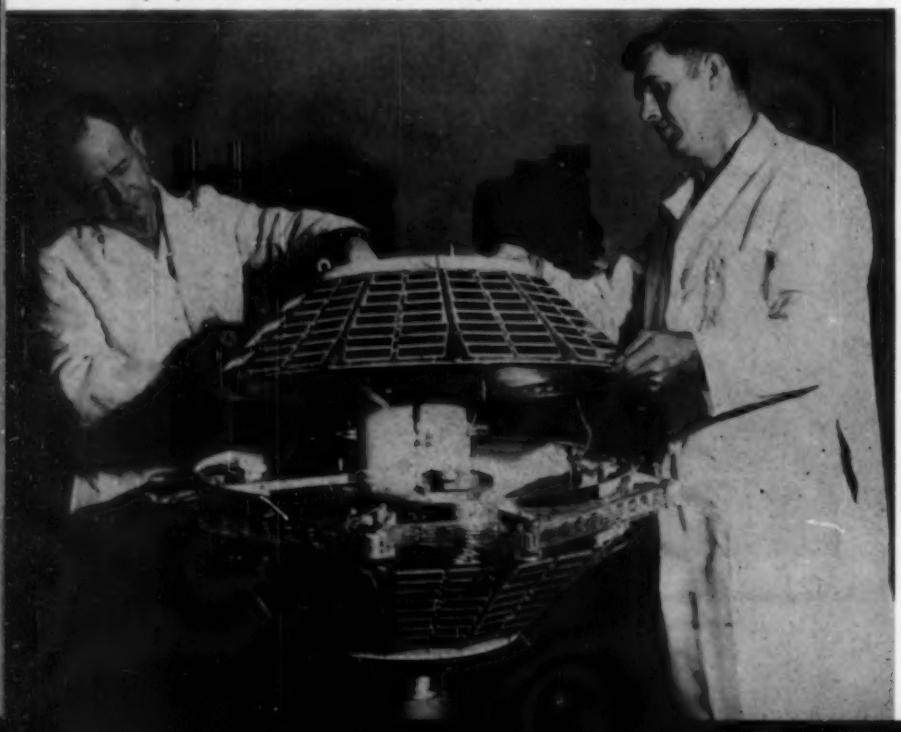
NASA's S-

85-lb. package will ri… Delta vehicle into orbit fo… intensive study of particle… in near space



ABOVE: *Schematic design of NASA's S-45 ionospheric beacon satellite, scheduled for launching by a Juno 2 vehicle from Canaveral last week. Shot was scrubbed.*

BELOW: *Workers at NASA's Marshall Space Flight Center put together the main body of the S-45 satellite, designed to probe the ionosphere with six radio beacons.*



NATIONAL AERONAUTICS and Space Administration plans to launch satellite *S-3* in about five months. This is an 85-lb. satellite that will make the most concentrated investigation to date of radiation and energetic particles in the space near the earth.

"We are trying to get as much as we can pack into one satellite," says Morton Stoller, in charge of satellite and sounding rocket programs on the staff of NASA space flight chief Abe Silverstein.

Current plans calls for at least 10 experiments aboard *S-3*, assuming that all can be packed into the weight and space limitation, and that the total power drain will not exceed about 5 watts.

A *Delta* vehicle is to launch the satellite into a highly elliptical orbit, with perigee of a few hundred miles and apogee of 30,000 to 40,000 miles. Solar-cell paddles will be folded down over the final-stage *Altair* and bound with nylon cord. A pyrotechnic cutter will release the vanes when the craft is in orbit.

• **Planned payloads**—These experiments are scheduled to be aboard:

–A solar proton analyzer, to register particles in the 200 ev-20 kev range, by Michael Bader of NASA's Ames Research Center.

–A flux-gate magnetometer, sensitive to 1000 gammas, by Laurence Cahill of the University of New Hampshire.

–A pair of cadmium sulfide cells, one detecting protons and electrons with energy above 100 ev and the other with a magnetic "broom" that sweeps out electrons in the 100-500 kev range but lets protons through, by Brian J. O'Brien of the State University of Iowa.

S-[illegible]atellite to Investigate Radiation

ll rid[illegible]
rbit f[illegible]45 satellite launch-post-
article[illegible]ned last week—to study
[illegible]osphere in cooperative
[illegible]ort

–Two Geiger counters, one measuring the total count of 40-55 kev electrons, protons with energy above 50 mev and electrons with energy above 10 mev; and the other registering only protons above 50 mev and electrons above 10 mev, by O'Brien of SUI.

–A third Geiger counter registering protons with energy above 20 mev and electrons with energy above 2 mev.

–A double scintillation telescope measuring the total cosmic ray flux of fast protons, with energy above 700 mev, and a differential energy spectrum of regular protons in the 70-750 mev region and low-energy alpha particles, by Frank McDonald of NASA's Goddard Space Flight Center.

–A scintillation counter measuring protons in the 1-40 mev region and electrons in the 100 kev-5 mev region, by McDonald of Goddard.

–A pair of Geiger counters, one measuring electrons with energies over 300 kev and protons with energies over 7 mev, and the other measuring protons with energies over 75 mev and electrons with energies over 8 mev, by McDonald. A particle that registers on both Geiger counters must be a cosmic ray with energy over 75 mev.

–A scintillation detector for ions in the 100 kev-1 mev region, and electrons in the 10-100 kev region, by Leo Davis of Goddard.

–An unshielded solar cell, to compare its performance with the radiation measurements.

The magnetometer was added for the first time to a radiation experiment so that radiation levels could be collated with magnetic field variations.

Numerous deductions can be drawn from comparisons of simultaneous readings. For example, by subtracting the reading of one of the O'Brien Geiger counters from the other, it will be possible to get a reading of 40-55 kev electrons—which the Iowa group considers a highly significant reading for the Van Allen belt.

Stoller said the solar-cell damage experiment is especially important because, to date, there just isn't enough information to decide how much damage the Van Allen belts do. ¤

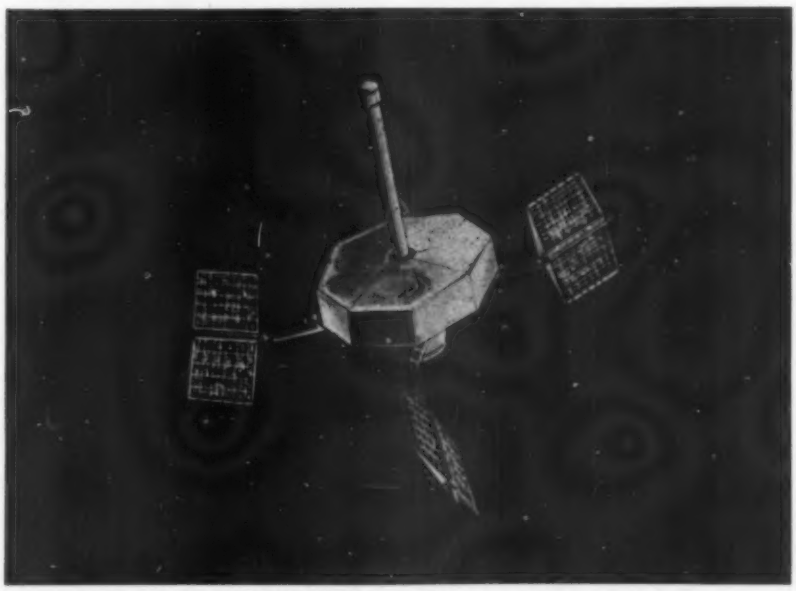
S-45 to be Tracked by New Zealand

A NEW ZEALAND research station and four U.S. scientific groups were set to cooperate with the National Aeronautics and Space Administration late last week in studying the ionosphere with the *S-45* beacon satellite.

The 74-lb. spacecraft, to be launched by a *Juno II* vehicle, carried transmitters for operation on six frequencies —20 mc, 40 mc, 41 mc, 108 mc, 360 mc and 960 mc. Ground stations can determine characteristics of the ionosphere by studying such signal characteristics as polarization and Doppler shift.

New Zealand has a particular interest in the ionosphere because its remote position in the world makes it particularly dependent on long-distance radio transmission. Its Seagrove Radio Research Station, part of the physics department of the University of Auckland, participated.

Other participants were Pennsylvania State University, University of Illinois, Stanford University and the National Bureau of Standards. Penn State established an equatorial recording station near the magnetic equator at Huancayo, Peru. Illinois has a part-time observing site at Baker Lake, Canadian Northwest Territories. Stanford has a station at the University of Hawaii. The Bureau of Standards operated from its Central Radio Propagation Laboratory, Boulder, Colo. ¤



S-3 RADIATION SATELLITE is shown in NASA artist's conception.

IRE Convention told . . .

Radiation Effects Are Little Known

Component testing for nuclear environments suffers from lack of standardization, limited experience

by Richard van Osten

LOS ANGELES—Lack of standards for electronic components subject to nuclear environments drew major attention at the Winter Convention on Military Electronics of the Institute of Radio Engineers.

Several speakers made it apparent that while many technologies are moving rapidly toward nuclear fields, efforts to standardize test procedures for semiconductor devices have been only partially successful.

Dr. L. B. Gardner, Litton Systems, Inc., said procedures for such tests are being developed but probably will not be firmed up for a year or two. Much of the standardization work is being accomplished by various committees of the ASTM and AIEE. The test approaches to determine sensitivity of electronic components to radiation fields are, however, usually picked according to personal preference or availability.

This makes it difficult to relate results from one test to another in terms of flux densities and dosimeter measurements, which generally are not much greater than 45% to 50% of absolute accuracy.

Reports generated from such tests are also poor, according to A. B. Kaufman, Litton Systems, in that they do not define critical neutron spectrums and usually involve sampling cross-sections too numerically low to be valuable. Transistors are particularly sensitive, Kaufman pointed out; he noted that any given transistor type will vary from manufacturer to manufacturer and even units from the same manufacturer will vary in characteristics with different batches made at different times.

One problem here, Kaufman said, is that while many transistors may be well qualified electrically, they often exhibit poor nuclear characteristics that eliminate their use for certain applications.

• **More specifics urged** — Elimination of generic reports on such tests in favor of reports with more specifics would help, it was made clear. Both Gardner and Kaufman agreed that there are an almost infinite number of nuclear environments possible and that the military should be somewhat more specific in stating test requirements.

Kaufman suggested that the present test "standard" of 2.9 mev seems valid for semiconductor tests, but tests could be conducted at various density levels —10^{12}, 10^{14}, 10^{15} and 10^{16} neutrons per square inch—to determine where satisfactory performance levels of each device might fall when exposed to a nuclear environment. This would provide basic component data to fit requirements of specific radiation environments and give researchers a "feel" for component selection.

Still another help for such programs would be a basic specification similar to the well-used MIL 5272 but covering nuclear requirements.

Contractors and researchers studying electronic component reaction to nuclear fields are up against a familiar problem. Dr. J. W. Clark, Hughes Aircraft Co., said there is no place at the moment for fundamentals in the work since all tests are to the letter of the contract in time, requirements and specifications.

• **Short on experience** — There is still little practical experience with nuclear or natural radiation fields other than in some areas of the Van Allen belt, Clark pointed out. Full-scale nuclear environments resulting from explosions or environments for electronic gear in nuclear missiles are difficult to simulate with reactor techniques. He urged also that work be pushed on radiation effects upon electron components in relation to component proximity to nuclear explosions.

A demand for such specific research is lacking, Clark said, adding that nothing is more depressing to a researcher or manufacturer than to develop something for which there is no demand. A good example of this, he said, are ceramic-type electronic devices which were developed principally because of their excellent high-temperature characterisitcs. Now the warehouses are full of them, Clark said; no one wants them.

Microcircuitry may hold the key to advanced electronic devices to operate in extreme radiation environments. Clark, Gardner and Kaufman agreed that the small size of such systems offers advantages in weight reduction for future space vehicles. In addition, shielding can be reduced by many factors, in turn reducing the very undesirable characteristic of a "step-up" transformer encountered with some shielding systems.

A whole new family of materials will grow with microcircuitry, the three experts agreed. Of special interest will be materials with low neutron absorption characeristics.

• **Traffic problem**—Satellite traffic in the future probably will run into the "low thousands," Ralph Deutsch and Richard B. Barrar of System Development Corp., told the meeting. The figure includes both "friendly" and "enemy" vehicles. With this amount of traffic expected, they said, it is necessary to develop some new techniques now for determination of satellite trajectories because "we'll run out of computer capacity very fast with real time relationships."

Asked if a system similar to the SAGE (Semi-Automatic Ground Environment) computer could handle data required for future satellite traffic requirements, Deutsch said it was not likely, noting that the SAGE computer was "overloaded from the day it was designed." ⌗

LOS ANGELES—Government-sponsored research and development programs in military electronics may be in for some sharp changes.

A Defense Dept. spokesman told the IRE winter meeting that changes in program handling are expected to bring about significant improvements. Dr. J. P. Ruina did not spell out the specifics of these changes but indicated some programs may be dropped in favor of new ones.

Dr. William Shockley, co-inventor of the transistor and head of Shockley Electronics, told the meeting a major problem with placing of government contracts was the "low technical competence of those holding the money belts." He recommended that salaries for DOD program management personnel be made competitive with industry. Dr. Shockley cited the Office of Naval Research as one of the military's best contract control agencies.

contracts

NASA

$[illegible],505—**Space Technology Laboratories, Inc.,** Los Angeles, for studies to determine the most economical space vehicle for future payload requirements beyond *Saturn*.

$30,125—**Douglas Aircraft Co. Inc.,** Santa Monica, Calif.,—same as above.

AIR FORCE

$12,000,000—**General Cable Corp.,** for control and communication cable for the first group of bases for the *Minuteman* missile.

$12,000,000—**Aerojet-General Corp.,** Azusa, Calif., for additional research and development work on the *Midas* infrared sub-system. Subcontract from **Lockheed Missiles and Space Division.**

$2,191,000—**Thiokol Chemical Corp., Redstone Div.,** for production of(M 60) solid-fuel rocket engines for the *Falcon* missile.

$600,000—**Chance Vought Electronics Div.,** Dallas, for electronic test equipment for the *Titan* program.

$150,000—**Defense Electronics, Inc.,** Rockville, Md., for state-of-the-art telemetry receiving equipment.

NAVY

$19,314,432—**General Dynamics Corp.'s Electric Boat Div.,** for drives and controls for the 600-foot "Big Dish" radio-telescope under construction at the Naval Radio Research Station at Sugar Grove, W.Va.

$3,592,460—**Remington Rand Univac, Military Dept.,** St. Paul, for production of peripheral equipment for the Naval Tactical Data System and continuing work on the "software" phase of the program.

$1,700,000—**Norris-Thermador Corp.,** Los Angeles, for *Polaris* A-2 first-stage rocket motor cases. Subcontract from **Aerojet-General Corp.**

$985,000—**Giannini Controls Corp.,** Duarte, Calif., for counting accelerometers for installation in the fleet aircraft.

$286,000—**Bulova Watch Co., Electronics Div.,** for frequency control devices for the command guidance of the *Bullpup* missile. Subcontract from **The Martin Co.**

$72,849—**Republic Aviation Corp.,** Farmingdale, L.I., N.Y., for plastic radar reflectors to be used in conection with shipboard missile guidance systems. Subcontract from **Raytheon Co.**

ARMY

$8,564,000—**Western Electric Co.,** for work to be performed on the *Nike-Hercules* missile system ($4,000,000 for production engineering services; $3,064,000 for research and development; $1,500,000 for the development of field manuals on the improved missile).

$5,900,000—**Sperry Utah Engineering Laboratory,** Salt Lake City, for continued work on the *Sergeant* weapon system.

$3,345,596—**Norris-Thermador Corp.,** Los Angeles, for warheads, rocket motor and body assemblies for 89,875 multiple rocket launchers.

$2,400,000—**Sperry Utah Engineering Laboratories,** Salt Lake City, for production engineering services for the *Sergeant* system.

$1,095,161—**Radio Corporation of America,** for work on an advanced radar to be used for in-flight study of ballistic missiles.

$463,000—**Sperry Utah Engineering Laboratory,** Salt Lake City, for improved radar tracking-plotting system.

$174,988—**ALCO Products, Inc.,** Schenectady, N.Y., for continued technical study of operation, testing and maintenance of three field nuclear power plants.

LONG RANGE INPUT / 1794

News of the recapture of Condé from the Austrians was sped to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's amazing télégraphe aérienne, or relay aerial telegraph, Sept. 1, 1794. A new era in rapid communications had begun.

Today, instantaneous and completely reliable Electronic Communications insure the immediate and continuous interchange of intelligence throughout the Free World. ECI is proud of its initiative and responsibilities in the design, development and manufacture of high precision electronic equipment to the critical specifications required in various aerospace and surface roles vital to our National Defense and to scientific achievement. An example is ALRI—Airborne Long Range Input—a program where ECI communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning system to SAGE—our continental defense network.

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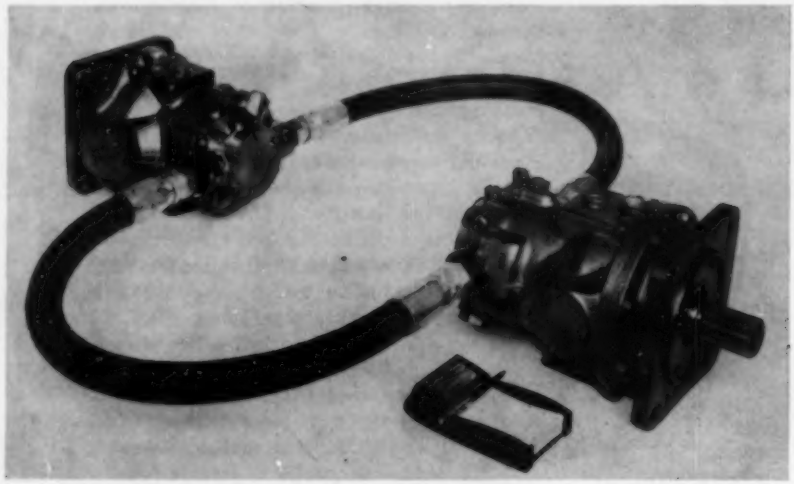

Hydrostatic Transmission For Mobile Use

Hydrostatic transmissions are available to mobile equipment manufacturers from the Watertown Division of The New York Air Brake Co.

In its simplest form the DYNAPOWER transmission consists of a variable displacement axial piston hydraulic pump which is coupled directly to the vehicle's engine, and a fixed displacement — otherwise similar — hydraulic motor which drives directly into the differential. High pressure hoses replace the conventional drive shaft, universals, gear changers and clutches. The speed and direction of rotation of the hydraulic motor are determined by the position of the pump's variable cam. Other combinations of single and dual, fixed and variable pumps and motors are available for applications having different performance requirements.

DYNAPOWER'S infinitely variable speed ratio is always under the operator's complete control so that the transmission is always working for him—not vice versa.

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Hi Temp Gas Servo

A gas servomechanism, representing a technical state-of-art advance, is available from Weston Hydraulics, Ltd.

Principal advantage of the system, is that it retains the desirable performance characteristics of a hydraulic control system yet operates far beyond the environmental limits of hydraulics.

Developed for use at temperature extremes and in space or nuclear environments, this system has only three basic components—the gas actuator for either hot or cold gases, a servo valve, and a feedback system with an exclusive and simple mixing network.

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Thermoelectric Generators

Westinghouse Electric Corp. is prepared to design and manufacture a broad line of thermoelectric generators for commercial and industrial applications.

Four units, in ratings of 5, 10, 50 and 100 watts, are available and are typical of the range of devices that can be produced to orders.

The generators are completely static and are ideally suited for applications in remote locations. Depending on the application and the type of fuel used, the generators operate at core temperatures between 300 and 600°C. Typical units burning propane gas operate at 400°C.

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Crimp-Type Contact

Elco Corp. is marketing a crimp-type contact, Varilok. Varilok will accept all wire sizes from numbers 18 gauge to 30 gauge. Varilok contacts are available loose, part number 8007.0313, with two sizes of hand-tools for crimping; and in reel form, part number 8007.0323, with power operated bench machine. Hand and power tools, plus a tool for inserting and withdrawal of contacts from connectors, are available.

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Synchro Transmitter

Angler Industries have available a line of synchro and resolver transmitters which feature front-panel mounting. A sub-miniature control dial allows the shaft of the synchro or resolver to be positioned with ¾° accuracy and 0.25° resolution. Zero may be set from the dial front without special tools. (Operates at 60 or 400 CPS with input voltages to 115 volts.)

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Sub-Miniature Accelerometer Marketed

A sub-miniature, non-pendulous, constant-damped linear accelerometer weighing less than 3 oz. and slightly under 1 in.³ in volume is available from Minneapolis-Honeywell's Boston Div.

The instrument provides independent control of natural frequency for any given G-range. Control of the natural frequency is achieved through use of variable area fluid coupling.

The instrument operates at peak efficiency within a temperature range of −65° F. to +250° F. and will withstand shock up to 100 G's and vibration up to 2000 CPS at 30 G's.

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Electronic Gaging Unit

An Electronic Gaging Unit, Electro-Probe, is available from Federal Products Corp.

Basic components are a small versatile gage head and light-weight, all-transistor, battery operated amplifier-meter. The Electro-Probe is normally powered by a mercury cell battery pack which provides over 1200 hours of continuous or intermittent operation. Optionally the user can power the unit with individual mercury cells or carbon cells or operate it from regular power lines.

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Low Impedance Diode

An extremely low dynamic impedance 6.2-volt temperature-compensated zener diode is available from Motorola Semiconductor Products, Inc.

With the low dynamic impedance characteristic, the type IN821A diode minimizes voltage fluctuations due to changes in current. It has a maximum impedance of 10 ohms, and a typical value of 8 ohms.

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names in the news

WILSON

BULCK

GREEN

SKINNER

OKUBO

Charles Vanden Bulck: Joins American Machine & Foundry Co.'s Government Products Group as manager of procurement. Was formerly assistant manager for administration of the U.S. Atomic Energy Commission's Oak Ridge Operations.

H. Champman Rose and **Chester A. Thompson:** Former chairman of the board and board member, respectively, of Jack and Heintz, elected to the board of directors of The Siegler Corp.

William A. Rabe: Appointed manager of the new Surface Radar and Electronic Warfare Development Laboratory in the Military Products Division of General Dynamics/Electronics. Prior to joining the firm, Rabe was manager of the Radar Receiver Engineering Laboratories of the Crosley Div. of the Avco Corp.

G. Robert Jacob: Former chief engineer for Measurements Research Co., joins Monitor Systems, Inc., a subsidiary of Epsco, Inc., as project manager.

Samuel L. Sola: Former assistant to the chief of Mechanical Systems Engineering at Nortronics Div. of Northrop Corp., joins the Ford Motor Co.'s Aeronutronic Div. as manager of automotive design for automotive electronic equipment operations.

Dr. Shigeo Okubo: Named manager of gyro platforms for the Precision Products Dept. of Nortronics. Prior to joining the firm he was engineering section head at Lear, Inc.

Maj. Richard W. Brunson: Replaces **Lt. Col. Paul J. Daigle** as senior representative of the Army Ballistic Missile Agency for the *Sergeant* program at Sperry Utah Engineering Laboratory.

James H. Green, Jr.: Appointed director of the Space Communications Division of the Alpha Corp., succeeding **Dr. J. E. Froehlich.** Green was formerly project director for Space Tracking and Communications.

Dr. Herbert C. McKee: Appointed assistant director of the Department of Chemistry and Chemical Engineering of Southwest Research Institute.

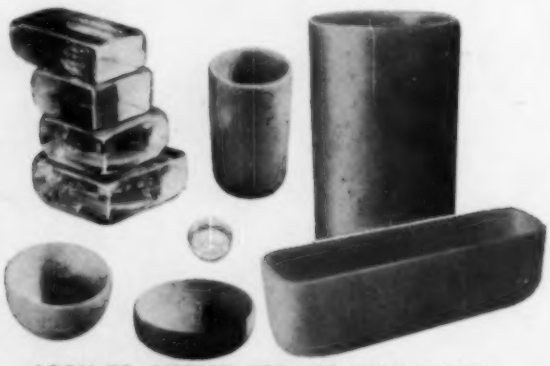
Dr. Selby M. Skinner: Former chief scientist to the deputy for research of the Air Research and Development Command of the Air Force, appointed manager of molecular electronics projects at Westinghouse Electric Corp.'s Air Arm Division.

Dr. E. J. Robb: Former project engineer for the *Minuteman* inertial guidance system, appointed head of the System Analysis Section of Space Technology Laboratories, Inc.'s Inertial Guidance Dept.

Charles E. Rees, Jr.: Former project manager, named director of research for Actuation Research Corp.

John L. Wilson: Former manager of product development at Hercules Powder Co., named manager of Taylor Fibre Co.'s newly created division for production of filament-wound, reinforced plastic parts.

Michael Newlon, 17-year-old son of **Clarke Newlon,** Consultant for Military Affairs for AMERICAN AVIATION PUBLICATIONS, is among 40 national winners in the 20th annual Westinghouse Science Talent Search, chosen from more than 25,000 competitors.



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letters

Space Blood Pressure

To the Editor:

I enjoyed your article on *Sputnik V* (M/R, Jan. 23, p. 22) which carried the two dogs, 40 mice and other assorted living specimens. In it you mention that the Russians telemetered respiration, electrocardiograms, temperature and blood pressure from the dogs in flight. The article further states that no information was available on the method of measuring blood pressure. If the technique used in this flight was the same as used in previous ballistic and orbital flights (and it appears to be from reference to the exposed carotid artery) the technique employed is known as the oscillometric method of determining blood pressure.

In operation the vessel in which blood pressure is to be measured is surrounded by an inflatable cuff. To the cuff are connected two pressure indicators, one registering mean pressure and the other pulsatile (oscillometric) pressure only. The cuff is inflated to a pressure above suspected systolic and the oscillometer indicates only small pulsations. As the occluding cuff pressure is released, blood spurts through when the peak blood pressure (systolic) is greater than the occluding pressure. At this pressure, the oscillometer indicates larger pulsations. As the occluding pressure continues to fall, the magnitudes of the oscillations increase then decrease. The cuff pressure at which they decrease sharply is the minimum pressure (diastolic).

While the oscillometric method of measuring blood pressure is not as accurate as the auscultatory method used by all physicians, this latter method cannot be used in areas of high ambient noise. However the oscillometric method can indicate changes in blood pressure, probably the main interest of the Russian physiologists.

Although the oscillometric method of measuring blood pressure is not an invention of the Russians, it is interesting to note that the familiar method of measuring blood pressure, which is the technique employed routinely by all physicians, was invented in 1905 by a Russian named Korotkow.

L. A. Geddes, M.E., Ph.D.
Department of Physiology
Baylor University
College of Medicine
Texas Medical Center
Houston

Waterloo Remet

To the Editor:

I cannot resist the temptation to query the historical accuracy of the interesting article (on Lt. Gen. Roscoe C. Wilson, AF Deputy Chief of Staff/Development) entitled "Scholarly Gentleman" (M/R, Dec. 5, 1960, p. 13).

I suggest a better historical allusion might have been to the tactics of GRANT in NORMANDY or, if desired to retain the British connection, to those of WELLINGTON at ALAMEIN.

Brigadier J. D. Adams, OBE
Trials Establishment Guided
Weapons, Royal Artillery
Ty Croes Camp, Anglesey
N. Wales, U. K.

In the Wilson profile, M/R referred to "the tactics of Marlborough at Waterloo." Our attention was drawn to this slip earlier (Letters, M/R, Jan. 2, p. 48).—Ed.

when and where

FEBRUARY

Second Annual Symposium on Nondestructive Testing of Aircraft and Missile Components, (unclassified), **South Texas Section of the SNT and Southwest Research Institute,** Gunter Hotel, San Antonio, Feb. 14-16.

Institute of Radio Engineers, International Solid-State Circuits Conference, 8th Annual Meeting, Sheraton Hotel and University of Pennsylvania, Philadelphia, Feb. 15-17.

American Society for Metals, Albuquerque and Los Alamos Chapters, Recent Developments in Materials for Nuclear Applications, University of New Mexico, Albuquerque, Feb. 16-17.

American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, St. Louis, Feb. 19-23.

Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles, Feb. 26-Mar. 1.

American Institute of Chemical Engineers, National Meeting, Roosevelt Hotel, New Orleans, Feb. 26-Mar. 1.

Armed Forces Management Association, Annual National Conference, Shoreham Hotel, Washington, D.C., Feb. 28-Mar. 2.

Association of Iron and Steel Engineers, Los Angeles, Feb. 28-Mar. 2.

MARCH

Optical Society of America, Roosevelt Hotel, Pittsburgh, Mar. 2-4.

Gas Turbine Conference and Exhibit, sponsored by Gas Turbine Power Division of American Society of Mechanical Engineers and U.S. Department of Defense, Shoreham Hotel, Washington, D.C., Mar. 5-9.

Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, PCNS, AIEE, IAS, University Museum, Philadelphia, Mar. 9-10.

Institute of the Aeronautical Sciences, Flight Propulsion Meeting, (classified), Cleveland, Mar. 9-10.

American Rocket Society, Test Operations and Support Conference, Biltmore Hotel, Los Angeles, Mar. 13-16.

American Society of Mechanical Engineers, Aviation Conference, Statler Hotel, Buffalo, N.Y., Mar. 13-17.

1961 Missile/Space Conference and Goddard Memorial Dinner of the National Rocket Club, Sheraton Park Hotel, Washington, D.C., Mar. 14-16.

Fifth National Conference on Aviation/-Space Education, Mayflower Hotel, Washington, D.C., Mar. 16-18.

American Congress on Surveying and Mapping, and American Society of Photogrammetry, Convention, Shoreham Hotel, Washington, D.C., Mar. 19-25.

IRE International Convention, Coliseum and Waldorf-Astoria Hotel, New York, Mar. 20-23.

Nuclear Congress, Nuclear Engineering and Science Conference sponsored by 30 major engineering societies and Engineers Joint Council, Chicago, Mar. 20-24.

American Society for Metals, 12th Western Metal Congress, Ambassador Hotel, and **Western Metal Exposition** in Pan-Pacific Auditorium, Los Angeles, Mar. 20-24.

23rd Annual American Power Conference, Illinois Institute of Technology, 9 technical societies and 14 universities, Sherman Hotel, Chicago, Mar. 21-23.

American Chemical Society, National Meeting, St. Louis, Mar. 21-30.

4th Symposium on Temperature, Its measurement and control in Science and Industry, sponsored by ISA, American Institute of Physics, National Bureau of Standards, Veteran's Memorial Hall and Deshler Hilton Hotel, Columbus, Ohio, Mar. 27-31.

American Nuclear Society, Nucleonics in Flight Symposium, Statler Hilton Hotel, Dallas, Mar. 28-29.

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AN ION ROCKET WITH AN ELECTRON-BOMBARDMENT ION-SOURCE. Harold R. Kaufman. Order NASA Technical note D-585 from National Aeronautics and Space Administration, Washington 25, D.C. 38 pp., $1.

An ion-rocket engine with a 10 cm-diameter electron-bombardment ion source was investigated. Both theory and experimental results are presented in the report, which concludes that an electron-bombardment ion-source appears to be one of the most promising for ion rockets.

A STUDY OF THE POSITIONS AND VELOCITIES OF A SPACE STATION AND A FERRY VEHICLE DURING RENDEZVOUS AND RETURN. John M. Eggleston and Harold D. Beck. Order NASA Technical Report R-87 from National Aeronautics and Space Administration, Washington 25, D.C.

A study of the families of nonthrusting ascent trajectories during rendezvous with an orbiting space station and descent trajectories to the earth's atmosphere. Equations of motion are derived and results are shown for two typical orbits of the station (one circular and one elliptical orbit). Boundaries of launch (at time of booster burnout) and rendezvous conditions are given and the effects of delays in launch time are discussed.

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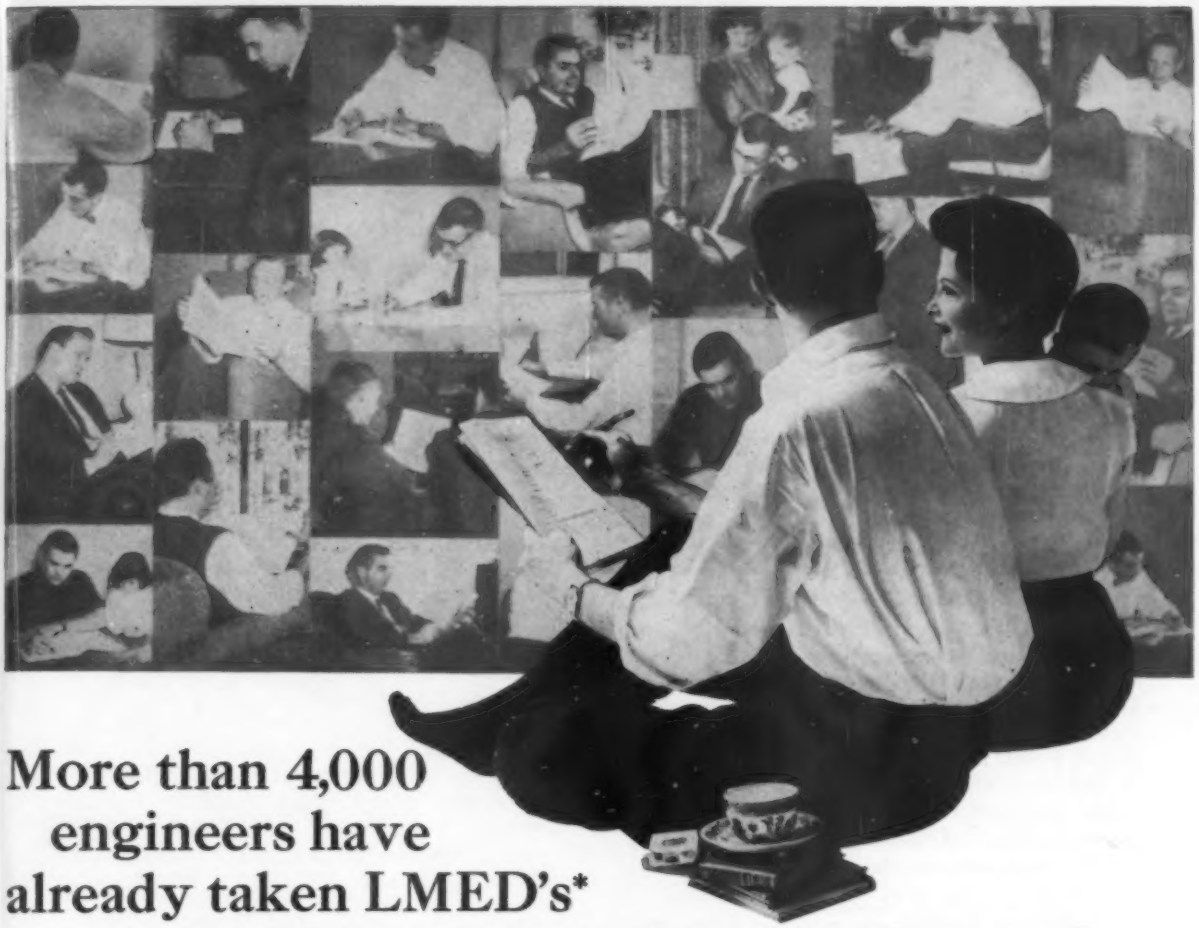

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editorial . . .

A Tempest In A Samovar

THE APPEARANCE of Soviet Gen. Mikhail N. Kostiuk and an aide at the American Rocket Society's conference on solid propellants at Salt Lake City touched off one of the most disgraceful, juvenile incidents we have encountered.

It certainly reflected no credit on the industry.

This is what happened: Gen. Kostiuk, air attaché at the Soviet embassy in Washington, was granted permission to attend the ARS conference. At a cocktail party on the opening night, Gen. Kostiuk was conversing with Associate Editor Frank McGuire of our West Coast staff. A photographer for Thiokol Chemical Corp. asked permission to take their picture and promised Mr. McGuire a print.

Mr. McGuire and the general agreed to be photographed—the latter somewhat reluctantly.

Later that evening, our associate editor was stopped in the hall by a Thiokol executive who told him: "Say, McGuire . . . We've been told by CIA that they don't think you should have that picture so we'll have to keep it." Mr. McGuire's request to talk to the CIA agents was turned down by the Thiokol official.

Remember, this was a photograph taken at an open cocktail party in a public hotel. It was taken at Thiokol's request with a promise Mr. McGuire could have a copy if he desired. It involved no government employees, no government facilities, no government equipment and no government information.

Mr. McGuire describes his reaction this way: "Until that statement I had no more than a passing interest in the picture; then the sheer brass of the people involved got under my journalistic skin."

Next morning, a Thiokol public relations man informed Mr. McGuire the FBI also had told the company to withhold the picture. Later, another Thiokol public relations man told him: "(An official) of the American Rocket Society is afraid you'll make a big story out of the Russians' presence, so he and (the Thiokol official) decided not to give you the picture so you couldn't print it."

At this point, ARS public relations manager Rod Hohl stepped in. Mr. Hohl had the good sense to realize what was happening and soon reported ARS objections to release of the photo had been lifted.

The photograph still was not forthcoming from Thiokol, however, as Mr. McGuire was referred to at least five different persons, each of whom disclaimed any knowledge of the whereabouts of the film.

Finally, at 1:50 p.m., Mr. McGuire told a Thiokol public relations man: "Harold Ritchey, Thiokol vice president and president of the American Rocket Society, is giving a press conference at two o'clock. That is ten minutes from now. If I don't have that picture, I will ask him before the television cameras and radio microphones why the photograph of a Russian general attending his technical meeting is so hard to obtain. I suspect he'll have a good answer, since he very likely hasn't the slightest idea what has been going on."

Within 10 minutes, Mr. McGuire received six copies of the picture.

Were CIA and FBI agents really involved? We don't know. Thiokol representatives later blamed ARS for the whole affair and ARS blamed Thiokol. The incident was no credit to either one.

WE ARE INVOLVED in a serious military and economic competition with the Russians, and it is about time we grew up in our attitude toward them. Did those people really expect to sneak a Soviet general into and out of an ARS meeting without the press becoming aware of it? Their ham-handed handling of the incident resulted in just the effect they were trying to avoid, a distraction from the technical importance of the meeting.

Gen. Kostiuk's conduct was quite proper. But the individuals involved from the missile/space industry acted like panicky schoolboys. Until we can be a little more adult about the presence of Russian officials at a meeting, perhaps it is best they not be permitted to attend.

We also would like to ask one more question. When was the last time the U.S. air attaché in Moscow was allowed to attend a Soviet meeting on rocket propulsion in a sensitive missile center 2000 miles from the Russian capital?

William J. Coughlin

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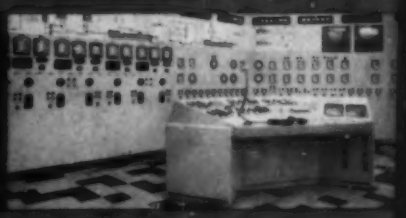

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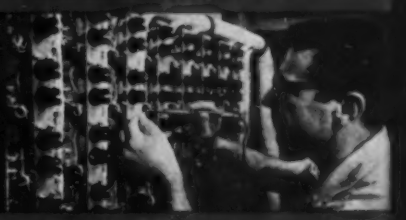

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